

# THE POLAR TIMES



Antarctica Adélie Penguin Rookery



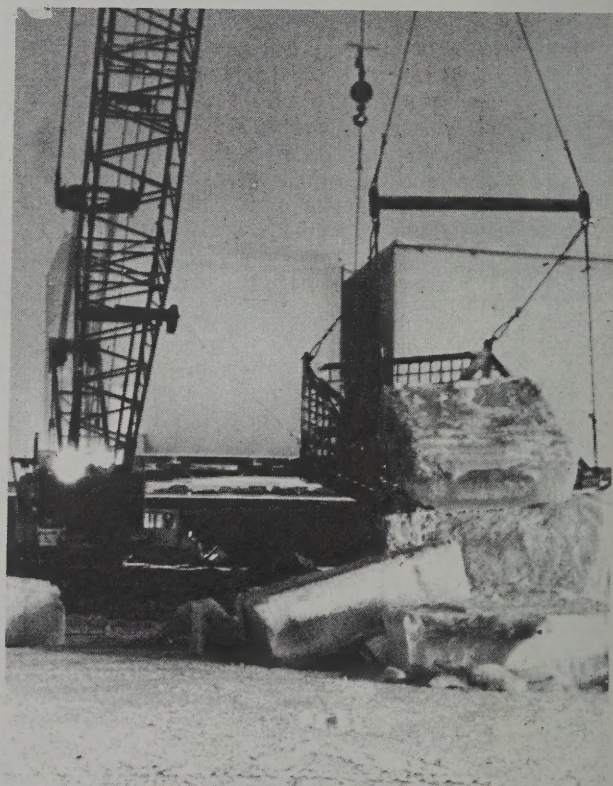


**Steller Sea Lion Rookery in Kenai Fjords.**

Daily News-Miner, Fairbanks



**ICE FISHING**—Alaska's native people often live off the land and winter is no exception. Here, residents of the village of Ambler, at the confluence of the Ambler and Kobuk rivers in Northwest Alaska, fish for white fish through the river ice.



**ICE CUBES**—A crane unloads some giant ice cubes cut from in front of a causeway being extended to stranded barges in Prudhoe Bay. Gravel is dumped into the holes where the ice has been removed. The barges are part of the fleet that arrived in October and froze in place before they could be unloaded. (ARCO photo)



# The Polar Times

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JUNE 1976

## 'Ice Age' May Hit

CAMBRIDGE, Mass. (UPI) — Scientists at the Massachusetts Institute of Technology are predicting that the world is going to get chilly. But don't buy a heavy coat for summer wear yet.

Dr. Hurd C. Willett, a meteorologist, predicted in an article in the latest issue of *Technology Review* that although temperatures will continue to drop, it will be about 125 years before a "little ice age" is expected to show up.

Willard says it probably will be from 10,000 to 30,000 years before a real ice age moves in. The "little ice age" could occur in a 30-year period during the first half of the 22nd century, from 2110 to 2140, at the peak of the current 720-year solar activity cycle.

Willard bases his weather predictions on his study of sun spot cycles over the past decades.

He has a good track record, including a correct forecast in 1951 that the temperature level over much of the world would fall significantly during the following 15 years. He predicted correctly a decline in hurricane activity along the North Atlantic coast, but a buildup along the Gulf Coast during the sixties.

—In the next 25 years, temperatures will fall significantly lower than in the past decade.

—There will be no major, prolonged drought in lower middle latitudes, except possibly in the Mexican border states of the United States.

—Upper latitudes will have a predominantly dry period, particularly in Canada and northern Europe.

—Africa and southern Asia are in for a 10-year period of severe drought.

—From 2000 to 2030, markedly warmer temperatures will return abruptly but will be followed rather quickly by a drop to even lower temperatures than before. Jan. 22

## Noise Docks Polar Star

SEATTLE June 9 (AP) The Polar Star, the U.S. Coast Guard's problem-plagued \$53 million icebreaker, is having troubles again.

A Coast Guard spokesman said the 399-foot vessel's initial ice breaking test is being cut short because of a "loud noise" and loss of power in the starboard propeller.

The problem was discovered Sunday while the ship was in the Bering Straits, south of Nome, Alaska. Up until then, ice breaking tests had been going well, the Coast Guard said, with the ship maintaining 7 knots through 4 feet of ice.

Polar Star, with a crew of 145 men, was to return to Seattle July 8, but is now expected back June 17. The spokesman said the ship will be able to make the return trip running on the two remaining propellers.

The first of a new class of icebreakers, the ship was commissioned Jan. 17 and ran aground the next day.

## Alaska Pipeline Estimated Cost Goes Up by 10% to \$7.7 Billion

By WALLACE TURMNER

The New York Times

SAN FRANCISCO, June 30 Estimates of the cost of the trans-Alaska pipeline went up 10 percent today, to \$7.7 billion, which will include \$55 million for correcting faulty welds.

A press release issued in Anchorage by the Alyeske Pipeline Company announced the new figures. The release made the point that labor productivity had been lower and material costs higher than expected.

In 1969, when the pipeline was first discussed, the cost was estimated at \$900 million, but by October 1974, after the first summer's experience in Arctic construction, an estimate of \$5.982 billion was made.

The new figure represents a 28 percent cost overrun in less than two years. The state of Alaska has a major interest in this, for, although it owns not a foot of the pipeline, it will pay about 20 percent of its cost, including the overruns caused by such matters as in-

spection of faulty welds.

Interviews in Anchorage last week showed that realization of the impact of the state's interest had begun to dawn among many who had not realized it before, while others had understood it all along.

Those interviews showed interest directed on the rewelding job along the 800 miles of pipeline. Incredulity over this has brought home to many Alaskans the fact that the state will share in paying for the pipeline in the exact ratio to its ownership of oil in the Prudhoe Bay field.

Former Gov. Walter J. Hickel, one of those who had known who would pay, recalled the general sly pleasure when oil companies began to borrow money as the pipeline costs mounted, and said he told his friends, "Don't clap your hands, because you're paying for it."

The reason the state will pay a share of the cost of construction is that the state, in effect, owns about 20 percent of the oil the minute it comes out of the ground. Those who own the oil must pay off the pipeline cost as the price of bringing the oil to market.

The state's ownership derives from the 12.5 percent royalty that Alaska will pay as owner of the land where the oil was found; and from a complicated severance tax schedule by which the state will take about 8 percent of the wellhead value of all the oil.

The oil, at wellhead, will be worth the market price delivered at a West Coast refinery, less the cost of delivery. The biggest share of the delivery cost will come from the pipeline charges, and these will be based on the cost of paving for and operating the line, plus a profit of 7 or 8 percent.

The pipeline will be treated as a common carrier, serving the oil transportation needs of the state and the 11 companies that own leases at Prudhoe Bay. The Interstate Commerce Commission will set the tariffs for shipping a barrel of oil out of the frozen North Slope, across the Brooks Range and to icefree tidewater at Valdez in Prince William Sound.

The transportation pricings



The New York Times



decision is of crucial importance. It has been calculated that a difference of one cent a barrel in the tariff would make almost a \$1 million a year difference in the state's income from taxes and royalties, once the pipeline reaches a flow of 1.2 million barrels a day.

The oil and gas division of the Alaska Natural Resources Department has a computer program that estimates what the pipeline transportation charges will be.

The last computer readout, last August, showed that, with only partial capacity on the line when it opens a year from now, the tariff might be \$4.50 a barrel, with the state's share \$1.53. By 1979, with full use, the tariff would fall to about \$1.84 a barrel, it estimated.

While Alaska is in a sense a partner with the oil companies in the Prudhoe Bay field, it owns no interest in the pipeline, although the oil companies that own big sections of the field also own major shares in the pipeline.

The shares of ownership of the oil by the companies is not yet precisely determined, for the field will be treated as a unit and the various ownerships will have assigned percentage shares of the oil produced. The percentages will be threshed out in debate where the arguments will be based on geologists' estimates of the amount of oil that exists beneath the tracks the companies have under lease.

Loosely estimated, Standard Oil of Ohio, which will be owned 54 percent by British Petroleum when the oil flow reaches a specific level in the winter of 1977, has about 50 percent of the oil. Atlantic Richfield and Exxon have 20 percent each. Eight others own about 10 percent among them.

These percentages roughly

## Computer Assists Remote Village

Anchorage Times

TANANA — A computer in Tucson, Ariz., and a communications satellite have joined to help provide health care to 20,000 Eskimos and Indians in Alaska.

The computer maintains complete medical histories of the Indians and Eskimos, helping the federal Indian Health Service prevent outbreaks of epidemics and reduce the incidence of chronic illness.

"Our goals are the early detection and prevention of health problems among the Eskimos and Indians through immunization and medical programs," said Jon Guthrie, director of health systems for the Bell Aerospace Co. in Tucson. Bell's health information system is operated under contract to the Indian Health Service, part of the Department of Health, Education and Welfare.

"Reports printed by the IBM system help us meet those goals by making sure that potential problems are followed up and not ignored," Guthrie said.

approximated in the pipeline ownership, except that only four of the smaller eight holders of leases divide the bottom 10 percent of the pipeline.

The expectation is that oil will begin to flow into the pipeline in early July 1977. The initial flow will be about 600,000 barrels a day, building to 1.2 million barrels by November 1977.

The Eskimos and Indians live in a rugged and sparsely populated Texas-sized section of central Alaska, where the severe climate, rough terrain and remoteness of their villages make transportation and communication difficult. Several villages are visited by physicians only twice each year.

Village health aides provide much of the medical care, consulting by radio with physicians at the Indian Health Service hospital in Tanana and the Alaska Native Medical Center in Anchorage. A communications satellite relays the messages.

Medical information gathered during field visits in the villages and Indian Health Service clinics is forwarded to Anchorage, where it is transmitted by wire to Bell's computer in Tucson.

The Arizona computer first was used to maintain health histories of the Papago Indians near Tucson. When that program proved successful Bell and the Indian Health Service expanded the operation to include the Alaskan natives.

Each week the computer reports the status of infectious or communicable diseases, enabling doctors to keep track of infected patients.

Whenever a particularly communicable disease is identified, the computer alerts the health authorities, who then take steps to check the patient's contacts and isolate

the disease before it becomes an epidemic.

Strict security codes, which are changed regularly, restrict access to the records to authorized health officials.

"We have the medical knowledge and ability to help the Eskimos and Indians," said Thomas Plumley, Bell's health information system project manager in Anchorage. "The system helps health care providers do a better job in applying that knowledge, by launching effective programs based on information that otherwise wouldn't be available."

## Whaling Authority Reduces Quotas

LONDON, June 26 (Reuters) —The International Whaling Commission set sharply reduced quotas today for the next whaling season despite strong objections by Japan and the Soviet Union.

The two principal whaling nations, which account for about 90 percent of the world's catch, expressed dissatisfaction at the decisions, which cut the global quota to 28,050 whales from last year's 32,578.

Delegate Yoshihide Uchimura of Japan said he was "very much disappointed," but did not say whether Japan would file an objection under the commission's rules. A member country is not bound by the commission's decision if it files an objection within 90 days.

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AUGUST HOWARD, Editor

THE POLAR TIMES highly recommends "The Polar Record," published by the Scott Polar Research Institute, Cambridge, England.

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## Solution to Svalbard "Wife Dispute"

An amicable solution to the so-called "wives dispute" between Soviet airline Aeroflot and Norway's Aviation Directorate has now been found. The dispute arose last Christmas when Russian ground staff at Norway's new Longyearbyen airport in Svalbard (where the Soviet Union has a mining colony) moved their wives in.

The Norwegians have claimed that the rooms these couples occupied are for one person only, and the appearance of the women has been widely seen as a challenge to Norway's Svalbard sovereignty. The Russian argument was that the tenancy agreement for the five rooms involved does not prohibit the wives.

Soviet residents connected with the airport will now be limited to one family with children plus five other persons. So if a Russian wants his wife with him, someone else will have to move out.



## Arctic Research Platform:

### Call for Suggestions

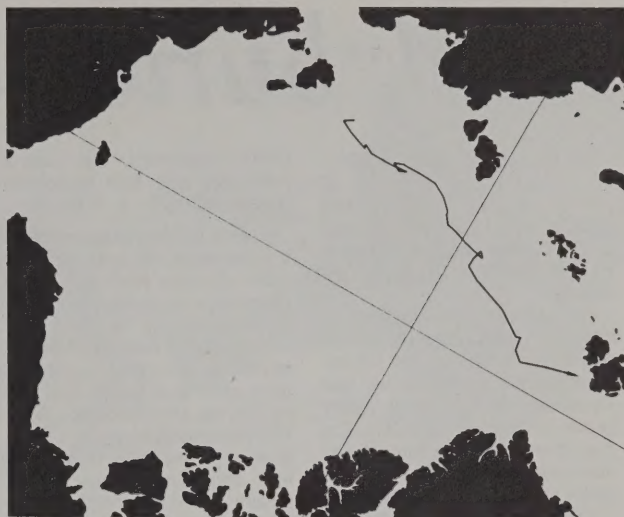
**T**HE NATIONAL RESEARCH COUNCIL Polar Research Board invites comment from U.S. and foreign scientists on scientific opportunities—including opportunities for international participation and cooperation—that may be opened by using an old icebreaker as a drifting research platform along the Arctic Ocean path of pioneer oceanographer Fridtjof Nansen's ship *Fram*.

Nansen, a Norwegian, deliberately put the *Fram* into the Arctic ice in the northern Laptev Sea in 1893 in order to drift with the ice, studying winds and currents. In 1896, after drifting 2,000 kilometers across the Arctic, the *Fram* broke out of the ice between Spitsbergen and Greenland. The Nansen expedition was epic in courage and in scientific productivity, and there have been suggestions in recent years to follow the Nansen drift path with a modern platform. The National Academy of Sciences' Committee on Polar Research, now the Polar Research Board, recommended in 1963 that support be given to a plan to freeze a ship into the Arctic pack ice.

The possibility of a Nansen Drift Station has been under study in recent months in U.S. Government basic-science agencies and in the U.S. polar-research community.

A Polar Research Board Committee on the Nansen Drift Station Project has been developing, with the help of several working groups, a scientific plan for crossing of the Arctic Ocean's Eurasian Basin along a track approximating that of the *Fram*. The committee—chaired by Norbert Untersteiner, University of Washington professor of atmospheric sciences—was scheduled to issue its report—an initial assessment—early this year.

The research platform and base is expected to be a *Wind*-class icebreaker scheduled for decommissioning this year by the U.S. Coast Guard. It is expected that the proposed scientific program will be multidisciplinary, ranging from study of plate tectonics to the study of effects of high-energy solar particles on the earth's magnetosphere. The platform's anticipated path would be over the locale of mid-ocean sea-floor spreading, of particular interest in global tectonics. It is expected that, because of the low sedimentation rate in an ice-covered ocean, long piston cores would be obtained with a heavy, ship-borne winch to provide new paleoclimatic information otherwise unobtainable. While the physical oceanography of the Arctic Ocean's Canadian Basin is relatively well



understood, little information is available on the Eurasian Basin, where sea-ice-atmosphere interaction may be especially intense and of significance to climate.

The Nansen Drift Station would be a research platform; therefore its scientific program would have several discipline-oriented efforts rather than a single scientific focus.

As now envisioned, the station would begin its two-to-three-year passive drift late in 1977, coinciding with the First GARP (Global Atmospheric Research Program) Global Experiment. This raises possibilities for merging observational programs of POLEX (Polar Experiment), one of the GARP sub-programs, with those of the Nansen Drift Station. This could be possible also for portions of the 1976-1978 International Magnetospheric Study.

It is expected that the project will be a multi-agency U.S. program with participation open to all and that all research data from such a project would be made publicly available.

The Polar Research Board, of the National Research Council's Assembly of Mathematical and Physical Sciences, is anxious to receive suggestions and comment from all interested scientists and scientific organizations and agencies, in the United States and in other countries, on the Nansen Drift Station idea as it evolves. Comments may be sent to: Polar Research Board, National Research Council, National Academy of Sciences, 2101 Constitution Avenue N.W., Washington, D.C. 20418, U.S.A. (Cable Address: NARECO).

## Scientists Study Haze Over Barrow

### Anchorage Times

**BARROW** — A recurring band of yellowish-brown haze found at times 6,000 to 7,000 feet above Barrow is being studied to determine if it is natural or the result of pollution.

The haze is similar to that found over cities where pollution is a problem, according to scientists at the Naval Arctic Research Laboratory.

Dr. Glenn Shaw of the University of Alaska and Dr.

Kenneth Rahn of the University of Rhode Island are studying the phenomenon with funding by the Office of Naval Research.

Working under Dr. Rahn, Randy Borys has been gathering aerosol samples from the haze which when detected is about 2,000 to 3,000 feet thick.

The haze, according to Borys, generally occurs with a southerly or southeasterly

wind. Air mass movement analysis indicate it could originate in Europe or Eastern United States. Chemical analysis of the samples are expected to reveal whether the haze is natural or caused by man.

Air samples are gathered in flights over the area, even on clear days. The haze can only be detected from the air.

Clean air in Barrow normally contains less than 100 particles per cubic centimeter compared to 3,000 or more particles found outside cities. Even with the haze in the Barrow area, particle counts have only reached 500 so far.

Different filters are being used so the air particles can be

examined in a variety of ways. A high volume filter provides for a check for chemical constituents while a smaller filter will be checked under a scanning electron microscope. A third filter will be analyzed for ice nuclei, a necessary ingredient for ice crystal formation.

The possible effects of the haze on solar radiation levels also is to be checked.





# Rock buried at Point Hope

POINT HOPE, Alaska (AP)—Three hours after the body of Native leader and Alaska publisher Howard Rock arrived at Point Hope Sunday, villagers caught the first wale of the season.

"He brought joy instead of sadness," said Donald Oktollik at the services held in the village Episcopal church which had withstood Arctic winds since before Rock was born in 1911. The church was crowded with friends and associates of Rock, artist and editor of the Tundra Times.

The service consisted of scriptures and readings from Rock's last editorial by Oktollik and Wilfred Lane. The editorial entitled "a message to my fellow

Inuits," concluded, "stay close to your God and also remember your ancestors."

Rock's Eskimo ancestors were not forgotten—he was buried a short distance from the village cemetery next to his uncle, Chief Attungowruk, a powerful medicine man and chief who died in 1885. Rock's coffin was carried to a sled and pulled over the tundra by snowmachine. Those who came to his birthplace to pay their final respects followed on foot and snowmachine and a steady snowfall. Temperatures at the grave carved from permafrost and gravel hovered just above zero.

Rick had asked to be buried

next to the chief, described by one mourner as "the most powerful man in living memory," and the village honored that request. The grave was in sight of the whale-rib-bordered community cemetery, but farther from the village on a lonely strip of land. Attungowruk's grave is marked with a triangle of the towering whale bones, some as tall as eight feet.

"He was quite a hunter and one hell of a witch doctor," the mourner said of the long-dead chief. "When the Yankees came to whal at Point Hope, he drew a line of demarcation and apparently kept them out. They say he was murdered by one of his wives."

Rock died April 20 after a lengthy battle with cancer. Gov. Jay Hammond, one of many who noted his passing, said his death "has taken a giant from among us. No one can fill the void he leaves and few possess the qualities he brought to his work, his state, his many causes and to his friends."

"The villagers at Point Hope count the homecoming as responsible for the whale catch," said Tundra Times writer Lael Morgan. "The village survival depends on whales and that set the mood for the whole funeral. It was as if he entered the Pearly Gates and said, 'Send those folks a whale.'"

## Arctic Ice Data Ready

SEATTLE (AP) — The United States soon will have the most comprehensive information on arctic ice behavior in the world, a University of Washington scientist says. Dr. Norbert Intersteiner, who coordinated a seven-year, \$15 million international program of arctic field experiments, said, "Not even the Russians have such good information." The joint American-Canadian program, Arctic Ice Dynamics Joint Experiment (AIDJEX) was conducted on ice floes north of Point Barrow, in the Beaufort Sea. The information gathered fills a 30-volume manual.



## Nuclear-powered Icebreaker

The Soviet northern fleet has been reinforced with a new 492-ft nuclear-powered icebreaker, *Arktika*. This is the second vessel of this type, but somewhat larger than its nuclear predecessor, the icebreaker *Lenin*.

The icebreakers are part of the U.S.S.R. program to further develop the northern and eastern regions for their natural resources. New settlements are springing up around mines and oil and gas fields.

## Fuji Returns From Antarctica

The icebreaker Fuji returned to Tokyo from Antarctica Monday after landing Japan's 17th wintering team and supplies at the Japanese base there.

The Fuji, manned by a crew of 182 commanded by Capt. Tsunezo Kuramoto, brought back 10 members of the 17th Antarctica summer expedition team who had been engaged in oceanographic observations and other research activities.

The 30-man 16th wintering team had returned here by air on March 21.

The icebreaker also brought home about 100 meteorites collected by members of the 16th wintering team in Antarctica and about one ton of snow to be analyzed here.

The Fuji, which reached the Antarctic Ocean last December, left the frozen sea on Feb. 19.

April 20

## Soviet Asks Blimps For Arctic Research

Agence France-Presse

MOSCOW, Jan. 14—Soviet polar explorer Nikolai Blinov has called for the use of blimps powered by gas turbine engines and at a later stage by nuclear motors to carry out scientific studies of the Arctic icecap.



## Greenland bears

Greenland will issue this 5-krona stamp on Feb. 19, according to the Greenland Postvaesen in Copenhagen, Denmark. The design by Jens Rosing depicts a polar bear with two cubs. Engraved by Czeslaw Slania, the emission is printed in blue in sheets of 50 each.





# Dog sled, igloo fade Revolution in Eskimo life-style

By Ward Morehouse III  
Staff correspondent of  
The Christian Science Monitor  
Resolute Bay, Cornwallis Island,  
Northwest Territories

The silent, tundra world of Canada's 18,000 Eskimo is changing dramatically.

- Fifteen years ago, 200 Eskimo dog sleds crisscrossed Canada's eastern Arctic region near the fabled Northwest Passage in search of game. Today, although game is still plentiful, all but a few of the dog teams are gone. Snowmobiles, which can travel up to 130 miles a day, are faster and more predictable.

- Government-subsidized "prefab" houses have supplanted igloos, which now are used only during long hunting trips.

- Eskimo women who had never traveled beyond their isolated hamlets near the Arctic Circle attended the Canadian Conference of Eskimo Women in Pangnirtung on Baffin Island in July. Family planning, native land claims, and the impact of economic development on the far north were a new world for women who had previously devoted full time to making seal leather supple by walking on it by the hour or chewing it.

- Increasingly, Eskimo are choosing seasonal or full-time employment instead of their traditional role as hunters.

Mosessie Idlout, a Resolute Bay Eskimo, is one such wage earner. Unlike his parents, who were nomadic hunters, Mr. Idlout hunts "after work." He is a heavy equipment operator in a new lead-zinc mine near Arctic Bay on Baffin Island. His high wages are too great an attraction for him to turn back to his ancestors' simpler, but harsher life-style, he says.

Other Eskimo are choosing to become mechanics, machine operators, and small-business men.

Salaried employees earn about twice what



For Eskimo women — a glimpse beyond the world of children and seal leather

the Eskimo who hunts for fur makes in a year, says James Waleki, an economic development officer for the Northwest Territories government.

Whereas the average wage earner will earn up to \$10,000 a year, a full-time hunter is fortunate to net \$5,000, Mr. Waleki says. He estimates that only 50 percent of all adult Eskimo men in Canada continue to hunt for food, compared with nearly 100 percent 25 years ago. Greater availability of package food in the Arctic is one factor in this decrease.

New discoveries of natural gas and minerals are providing Eskimo with more opportunities for jobs. In 1972 approximately 1,600 Eskimo were employed in Canada's petroleum industry. Two years later the number had risen to 2,000.

Panarctic Oil, Ltd., which has discovered massive amounts of natural gas in the high Arctic islands, had only four Eskimo employees in 1970. Today, because of company and government training programs, it has 37.

The Canadian Government's goal is to help

its Eskimo people "catch up to a modern world," says Gunther Abramson, chief of the social development division of Canada's Department of Indian and Northern Affairs. Besides subsidizing housing and heating costs, the government is providing more low-interest loans to Eskimo entrepreneurs.

When the loan program began in 1954, the government made only 11 such loans that totaled \$19,000. Most were for the purchase of relatively small items such as canoes.

In 1974, 68 federal loans were granted to Eskimo; they amounted to \$1.4 million. Now Eskimo are investing in food stores and even in motels for tourists.

Unfortunately, the influx of miners, oilmen, and transportation workers has had some negative influence on the Eskimo. Alcohol abuse, which some government officials consider the "No. 1 Eskimo problem," takes increasing tolls on family life and health.

Many Eskimo and some government leaders are trying to combat such problems by teaching Eskimo more about their heritage and thus raising their pride in their identity.

## Amundsen Memorial Planned

A bronze bust of Norwegian polar explorer Roald Amundsen is to be unveiled at Ny-Ålesund in Svalbard on May 11. It commemorates the start of Amundsen's flight from Ny-Ålesund to Nome, Alaska, in the airship "Norge" fifty years ago. It is also hoped to unveil a similar bust in Nome on May 14, the date Amundsen arrived there after crossing the Arctic Ocean. In addition, there are plans for a third bust at the South Pole on December 14, the 65th anniversary of Amundsen's arrival there at the head of the first expedition to reach this point.





# Iceberg Patrol Carries Out A Hazardous, Tedious Task

By JOHN NOBLE WILFORD

The New York Times

April 23

The squat HC-130 aircraft of the United States Coast Guard crossed the 55th parallel over the Labrador Sea, headed north on a course off bleak Labrador, flying low and slow over a sea of ice.

The aircraft was two and a half hours out of St. John's, Newfoundland, on an "up-stream reconnaissance" of the International Ice Patrol. The crew on the flight deck carefully scanned the icescape to the right and left and straight ahead. They were looking for icebergs — bergs of all sizes and shapes, but particularly those likely to drift all the way down the frigid Labrador Current and pose a threat to North Atlantic shipping.

This is the patrol's mission every year during the iceberg season, from about March to midsummer: plotting the positions of menacing icebergs, tracking their ponderous drifts and dispatching warnings to ships at sea every 12 hours.

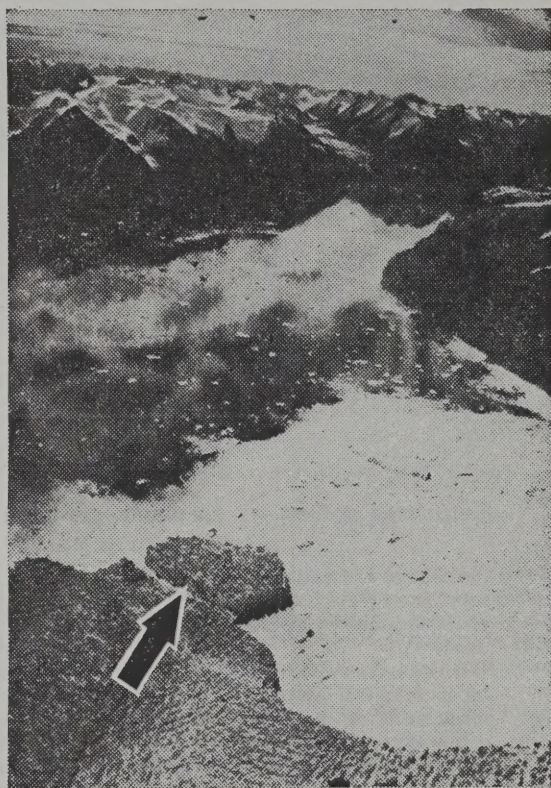
It can be monotonous and hazardous. Airborne six to eight hours a day, often in turbulent skies, often plunging through an undercast to within 300 or 40 feet of the choppy, icy waters, the patrol covers a 33,000-square-mile area of the Labrador Sea and the heavily traveled Grand Banks off Newfoundland.

## Under 20-Nation Treaty

But it is considered necessary. The patrol was established by international treaty after the disaster of the Titanic, which struck an iceberg off the Grand Banks and sank with a loss of more than 1,500 lives. Though the patrol is operated by the Coast Guard, 20 major maritime nations share the annual expense of about \$1.25 million.

This year, as a recent reconnaissance was finding out, has not been a good one for icebergs. So far, only 31 bergs have been plotted far enough south (but still above the 48th parallel) to be potentially hazardous; usually there should be several hundred at this time.

"Not much here. Nothing much to worry about," Cmdr. A. D. Super, the officer in



United States Coast Guard

Most icebergs that reach the North Atlantic and threaten shipping were created two or three years earlier along the west coast of Greenland. The arrow points to a berg, estimated to be about a mile wide at the break-off point, splitting off the end of a great glacier and floating into Baffin Bay fjord. After a journey of some 2,000 miles it may break apart and melt off Newfoundland.

charge of the Ice Patrol, commented as he surveyed the Labrador Sea. "We may have an early end of the iceberg season—in June, instead of July or August."

Off the Straits of Belle Isle there had been brash, loose white chunks bobbing in the swells like ice in a punchbowl. Then came clustering rafts of thin new ice and a spreading mosaic of second-year ice, thick survivors of one summer's melt riding higher in the water. Some, with icy ridges and hummocks and pools of bluish-green melt waters, were like miniatures of Arctic topography.

Farther north, off Sandwich Bay, there were vast floes locked in frozen embrace. Then Walter P. Ark, a chief marine science tech-

nician of the Coast Guard, called out, "Small berg to the right."

Chief Ark plotted the iceberg's position. The exposed part of the iceberg was about the size of a bungalow, but the visible tip of an iceberg represents less than 20 percent of its volume.

Other sightings followed, but nothing big. Some growlers, which are mini-bergs about the size of an automobile. Bergy Bits, which are chunks of ice that have split off a larger berg and are usually no bigger than a house trailer.

After crossing the 55th parallel, off Hopedale, Labrador, Lieut. Comdr. Roland Buster, the pilot, banked and nosed the aircraft down to 400 feet to get a closer look at a field of larger bergs,

much larger than an ocean liner. They were mostly blocky and flat-topped in shape, like floating mesas. But others had pinnacles and domed tops.

Commander Super said, "These bergs could reach Grand Banks by late May, if they survive."

Knowledge of the longevities and peregrinations of icebergs is imprecise.

Nearly all icebergs that eventually reach the North Atlantic were calved two or three years earlier along the west coast of Greenland. That is, they broke off the end of a great glacier and slowly floated out to sea. An iceberg is frozen fresh water — sometimes, depending on the age of the parent glacier, several thousands of years old—whereas the sea ice in floes is frozen salt water.

Caught in the north-flowing West Greenland Current, the thousands of bergs, some as long as a city block and half as high above the water, drift for months through Baffin Bay and spend their first winter in Melville Bay. Then they generally swing west and come under the influence of the south-flowing Labrador Current. This takes them to the neighborhood of Cape Dyer on Baffin Island for their second winter.

On the third and final leg of a typical journey, a few hundred of the original 10,000 bergs move south 10 to 20 miles a day. Some get trapped in bays and inlets. Heavy westerly winds drive others out of the cold center of the current, where they slowly disintegrate and melt.

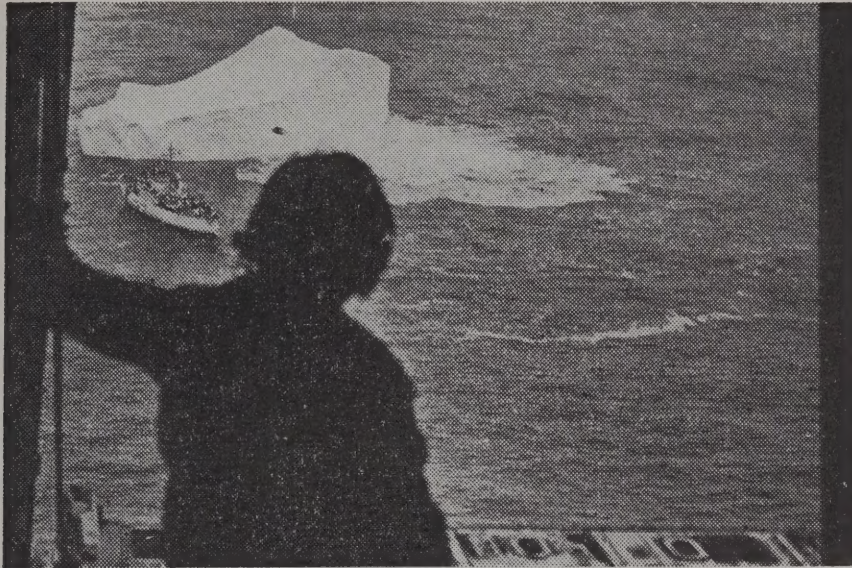
According to Ice Patrol experts, this is apparently what has happened to most of this year's crop of bergs.

As long as a berg remains locked in sea ice and in the center of the current, it keeps going. In the open sea, bergs toss and roll and, where cold waters of the Labrador Current converge with the northern extension of the warmer Gulf Stream, break apart and melt in two or three weeks. This is often after a journey of three years and 2,000 miles.

A rare iceberg has been sighted as far south as Bermuda or at a latitude out from Jacksonville, Fla.

After inspecting and plotting the icebergs off Hopedale, the patrol proceeded up the coast of Labrador and across the Davis Strait to Greenland. Those aboard who were crossing the Arctic Circle for the first time were





United States Coast Guard

A crewman of the International Ice Patrol opens the cargo door of an HC-130 aircraft for a look at the Coast Guard cutter Evergreen stationed next to an iceberg in the Labrador Sea, east of Newfoundland. Such patrols fly nearly every day from March until mid-summer to locate icebergs that could menace North Atlantic shipping.

properly initiated "by order of Boreales Rex." Their noses were painted blue.

The six and a half hour, 1,400-mile flight ended at Sondre Stromfjord, an air base about 100 miles inland

on the banks of a frozen fjord.

On the return to Newfoundland the next day, the patrol crossed the open Labrador Sea south of the Arc-

tic Circle. A few more bergs were sighted. But they were mavericks, having drifted out of the primary currents and therefore unlikely to reach the Grand Banks.

## Arctic Research Scientists Study Snowy Slope Secrets

### Anchorage Times

**BARROW** — With little data existing on snowfall on the Arctic slope, scientists at the Naval Arctic Research Laboratory are working to fill this void.

They are attempting to accurately determine snowfall rates and drift patterns on the North Slope to make life easier for the more and more people now living and working in the Arctic year-round.

Dr. Carl Benson, Rod March and Tom O'Grady, all from the Geophysical Institute at the University of Alaska, are doing research on the snow both at the research laboratory here and at the laboratory's Meade River field site.

In cooperation with the U.S. Forest Service, Benson is trying to solve practical problems relating to snowdrifting at Barrow and other North

Slope areas. He is devising a means of keeping drifts from the laboratory's animal research facilities where excess snow is a problem both in and around cages.

Knowledge of snow drift patterns also is viewed as an aid in construction of roads of snow and ice for winter use. It also could be used in directing drifts away from runways, roads and buildings in northern communities and construction camps.

Meade River is considered a prime site for studying drifts as it is subjected to two major wind directions, prevailing winds from the east and northeast and storm winds from the west.

Benson and his assistants have constructed "Wyoming-shield precipitation gauges" at both Barrow and Meade River to measure snowfall. Developed and tested since 1970 in Wyoming, these devices

are new to Alaska. They are designed to collect accurate snowfall measurements in windy conditions typical of the Arctic.

The shield consists of outer and inner concentric rings of four-foot high snow fencing tilted towards the center at 60 and 45 degrees. Within this shield is placed a standard collection container, about two feet high and eight inches in diameter, filled partially with antifreeze and water. A thin film of oil floats on the surface of the mixture.

As snow falls into the can, it melts and drops through the oil layer but cannot evaporate back out again. Each month the container is weighed and the weights converted into inches of snowfall.

Data from the Wyoming devices will be compared to that collected over years at Barrow by unshielded gauges. It is believed that only a third

## Rocket Launchings Set for Exploration Of Aurora Borealis

**WASHINGTON, March 27 (AP)**—Scientists are set to fire spiny, porcupine-looking instruments into the northern lights in an international effort to find out how the aurora borealis is produced.

The National Aeronautics and Space Administration said Tuesday that two single-stage sounding rockets would be launched from northern Sweden before April 4.

The 550-pound instrument packages, the largest believed carried by a sounding rocket, are to reach 300 miles above earth on 12-minute ballistic flights and splash down in the Arctic Ocean 285 miles from the launching site.

The packages developed by the United States and West Germany will be the first flown on the new Aries rocket. Aries are modified versions of obsolete upper stages of Minuteman intercontinental ballistic missiles provided by the United States Air Force.

The rocket payload in the German-United States study, known as Project Porcupine, has 12 quill-like booms extending from it. These extensions are to gather data for 11 experiments probing the aurora

and the electrical and magnetic disturbance beyond.

As each rocket reaches about 60 miles in altitude, it will eject two smaller probes carrying complementary instruments.

At 280 miles, each rocket is to explode two canisters of barium. The barium clouds, which will be photographed from aircraft and the ground, should show magnetic field lines and the drift of the charged particles making up the aurora.

A second pair of Project Porcupine rockets will be flown in 1977. The project is part of the 1976-78 International Magnetospheric Study, a 40-nation effort to explore the upper atmosphere.

or fourth of the total snowfall in windy areas is collected by standard gauges. With correlation of the two types of measurements, previous data will be converted into what scientists believe will be more accurate figures.

Similar measurements are planned by Benson at Prudhoe Bay and Barter Island.



# Icebreaker Helps Open a Gas Field in Siberia

By THEODORE SHABAD

The New York Times

The Soviet atomic icebreaker Lenin, in an unusual Arctic experiment, has succeeded in conveying a freighter through heavy winter ice to open a Siberian natural gas field from the sea side for the first time, the Moscow press has reported.

Setting out from its home port of Murmansk three months before the usual start of the Arctic shipping season in late June, the Lenin, with the freighter Pavel Ponomarev in tow, has reached the far northern Yamal Peninsula at 71 degrees north latitude to start development of a large gas field that has been inaccessible from the land.

Previous Siberian gas fields, which are among the largest in the world and have been viewed as potential sources of liquefied gas for the United States, have been put into operation with equipment trucked in over winter ice roads or flown in by helicopter.

The Russians have been seeking to ex-

tend the shipping season in the Arctic with the help of nuclear icebreakers, two of which are now in operation, with a third under construction. The Lenin, launched in 1959, was joined last year by the Arktika, and the Sibir is being outfitted in a Leningrad yard.

The Arctic sea route, which could be used only three months before the use of icebreakers and reinforced freighters, is of crucial importance for the Soviet Union as a supply route to northern industrial outposts.

The route is being used in particular to haul valuable metals, including nickel, copper and platinum, from the Norilsk mineral complex of northern Siberia. Norilsk is the source of most of the Soviet platinum exports to the United States.

In recent years, Soviet icebreakers managed to keep the sea lane open from June

through December, and the early start this year represents another effort to prolong the season.

The Lenin left Murmansk on March 29 and met the freighter, with a cargo of prefabricated buildings, trucks, bulldozers and other gas-field equipment aboard, at Kolguyev Island, on the edge of the Arctic ice.

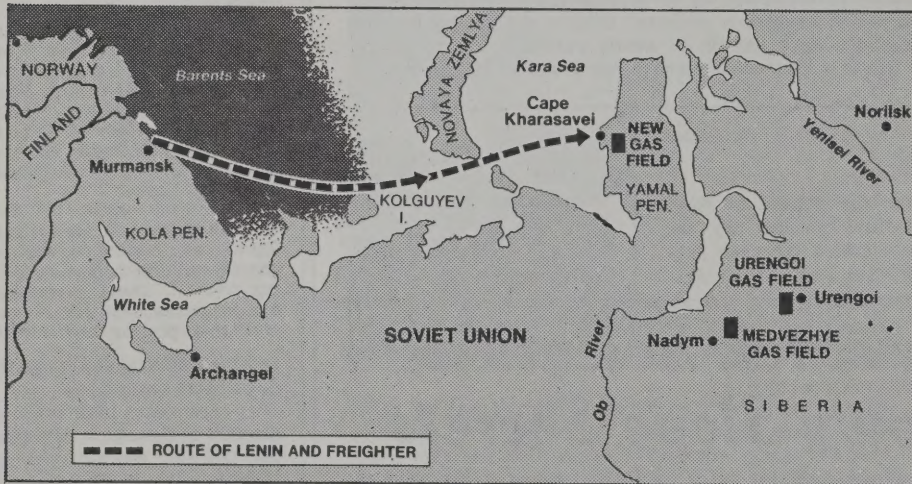
For 350 miles the Lenin rammed a path through the ice, often taking running starts of 100 feet or more to push her bow onto the ice so that it would break under the weight of the ship. Progress was limited to 1.5 to 2 miles an hour.

Ice conditions ahead were reconnoitered by a helicopter based on the Lenin and by a plane based at Amderma on the coast. The Russians also used photographs received from a special Soviet ice-reconnaissance satellite in orbit around the earth.

The two ships arrived April 6 at the edge of the heavy coastal ice that stretches about 25 miles off Cape Kharasavei. In five days the Lenin carved a narrow 20-mile channel for the freighter up to a point offshore where shallow water impeded further progress, and unloading began.

Gasfield workers had been flown in a month earlier to clear a road across the ice with bulldozers and tracked vehicles. They expect to take a week hauling the nearly 4,000 tons of cargo ashore.

Large-scale Siberian gas development began in 1972 with the opening of the Med-



The New York Times/April 19, 1976

Lenin towed a freighter through ice to site of gas fields

## Soviet Testing Missiles in Barents Sea

By DREW MIDDLETON

The New York Times

Sept. 17—

The Soviet Union began missile tests yesterday in the Barents Sea, an area strategically important to both the Russians and the North Atlantic Treaty Organization.

Western intelligence analysts consider the tests militarily and politically significant.

The tests, the analysts said, will demonstrate the extent and effectiveness of Soviet defenses of their huge naval-air complex around Murmansk, and, in Soviet eyes at least, will warn foreign powers of the dangers of espionage in peace

and attack in war.

Beyond this military demonstration lies the possible political pressure the tests will exert on Norway. The Soviet Union is about to negotiate with Norway over national boundaries on the continental shelf in the Barents Sea south of Spitzbergen. Soviet propaganda has frequently criticized the existence of NATO electronic installations in Finnmark, Norway's northernmost province, which lies across the Barents Sea from Spitzbergen.

The tests, announced by Moscow on Sept. 11, will continue until Sept. 27. According to Western sources they will be the first major tests of Soviet missiles outside the northern

or central Pacific Ocean. The splashdown area is 200 miles north of Murmansk and foreign ships and aircraft have been warned to remain outside the area between 10 A.M. and 9 P.M. local time.

The Russians, according to one analyst, "may be telling us something" in their announcement.

His interpretation of the message was that NATO, and particularly the United States, was being informed that the Murmansk naval complex is defended by an abundance of surface-to-surface, surface-to-air and antisubmarine missiles and that Moscow may think it necessary to warn off foreign

air or seaborne intelligence-gathering vehicles.

The Russians, analysts noted, have been highly sensitive about the security of the Murmansk area since the expansion of the Soviet Navy gathered momentum in the nineteen-sixties.

Murmansk is the only ice-free port from which Soviet warships can proceed to operational areas in the NATO area without first passing through potentially hostile territory. Ships assigned to the Mediterranean squadron, for example, must move through the Bosphorus and the Dardanelles in Turkish territory before reaching the Mediterranean.

The naval complex around Murmansk is of maximum importance to Soviet naval strategy. Murmansk is the home port of the Northern





The icebreaker Lenin during an operation in the Arctic

vezhye field, near Nadym, which accounted for 1.3 trillion cubic feet of gas last year, or 13 percent of Soviet output. The Urengoi field, to the east, is scheduled for a production start next year. This is the field that has been viewed as a supply

source for the United States under the so-called North Star project.

The current five-year plan (1976-80) calls for the Siberian fields to contribute about one-third of Soviet natural gas production, which is planned to reach 14 trillion cubic feet by 1980.

Fleet, the most powerful of the four major fleets. In addition, all Soviet ballistic missile submarines, including those normally deployed off the east coast of the United States, are based on Murmansk.

Since 1965, the Russians have constructed some of the largest and most sophisticated ship-building and ship-repair yards in the Soviet Union to support the Murmansk base. The area's air defenses have been strengthened and the marine infantry units stationed there reinforced.

Because of the strategic importance of the complex, NATO

has attempted to monitor sea traffic out of the port into the Atlantic employing radar, sonar and other devices at sea, in the air and ashore.

These attempts, in the view of some qualified sources, have been successful enough to increase Soviet security measures, including electronic jamming of foreign receivers.

The missile tests may have a second objective. Negotiations between the Soviet Union and Norway over the dividing line between the two countries on the continental shelf of the Barents Sea are to begin later this year. There are Western

# Natives Plan Polar Meeting

## Anchorage Times

April 8

In a family-reunion atmosphere, Arctic natives from far-flung homelands last week conversed in English and joked in Eskimo during three planning sessions at Barrow for a worldwide conference of Eskimos to be there in November.

The initial meeting was to plan the first Innuvit Circumpolar Conference. Scheduled for Barrow the week of Nov. 22. The planning sessions were chaired by North Slope Borough Mayor Eben Hopson and former state Sen. Willie Hensley.

The Eskimos have an \$80,000 planning grant for the meeting from the Lilley Foundation to "prime the pump so others will get on board," said John Buckholdt, a Hopson aide.

The conference hopefully will include Eskimos speaking six dialects through translators, United Nations-style, he said.

Concepts such as a racial "nation" of Arctic Eskimos will be discussed "because we

all hunt and share the same ocean and we don't want to see anything happen to it," said Billy Neakok, special mayor's aide.

The conference planners from most Eskimos enclaves around the globe also journeyed to Kotzebue for more rounds of preliminary talks.

"Even many of our names are the same," Neakok said.

Some 300 conferees and up to 60 formal delegates will be brought to Barrow for the meeting. The only group not represented during the planning sessions was an Eskimo community of northeasternmost Siberia.

"If we are forced to ask for the Russians by name so they can come, we'll just ask the people on Little Diomed Island for names of family in Russia they'd like to see," Neakok said. "We are budgeted for three delegates from there."

The common language of the Eskimos was of major interest at the planning meetings.

Frank Degnan, a longtime Eskimo leader, gave a speech switching from one dialect to another impressing and delighting visiting Eskimos from Greenland and Canada, said Neakok.

"The young people who came from there were thrilled to hear a rainbow of language," he said. "We were all very curious about one another and it was like getting to know your own family."

Representatives from Eskimo communities in Greenland, Quebec, Ontario the Northwest Territories and Alaska planned to talk of a "sixth" Arctic nation besides the five Arctic coastal countries negotiating an Arctic seabed treaty under United Nations auspices.

The sixth entity would be a philosophical and cultural nation of Eskimos, said Neakok.

Social and governmental problems Eskimos face wherever they live will be listed on a 14-point agenda approved by the planners.

estimates that the shelf contains valuable oil deposits and ample evidence that the Russians are aware of this.

Possibly because of this and possibly because of other, strategic considerations the Soviet Union also is attempting to strengthen its position on the Spitzbergen Archipelago, which bounds the Barents Sea on the northwest. The Russians have asked Norway for some type of special arrangement on Spitzbergen where there is a Soviet community of about 2,800 including 2,000 coal miners.

The United States, Britain, France, Italy, the Netherlands, Japan and a number of other countries as well as the Soviet Union have treaty rights to develop natural resources in the archipelago but since 1925 the islands have been incorporated in Norway.

A telemetric station at Ny-Alesund is operated by the Royal Norwegian Council for Scientific and Industrial Research to supply data received from satellites to the European Space Research Organization.



# Deep Divers of the Antarctic

by Gerald L. Kooyman

March 1976 *Natural History*

Two large warm-blooded animals—the emperor penguin and the Weddell seal—have overcome the forbidding environment of Antarctica to make it their year-round home. Unlike the host of other birds and mammals that come to the continent only in the summer to breed and to feed on its abundant marine life and then depart for either the pack ice or lower latitudes, these animals stay throughout the severe winter.

The emperor penguin has been known as a species, *Aptenodytes forsteri*, only since 1844. Yet, it is one of the largest of all birds and is the largest extant aquatic bird. Males can be up to four feet tall and some weigh more than ninety pounds, although the average weight of the species is between fifty and sixty pounds. The emperor's nearest relative is the king penguin, *Aptenodytes patagonica*, which lives on and around the subantarctic islands, particularly on South Georgia Island. Both species are similarly striking in their markings, with black backs and white to yellow breasts. The long and slender bill, which the emperor frequently uses along with its flippers for helping to raise itself out of the water and from a prone to an upright position, is delicately marked with blue and pink borders on a black base. The feathers, except for those on the wings and tail, are uniformly one to one and a half inches in length. They are narrow, with a downy filament at the base, and give the superficial appearance of fur.

Emperor penguins feed mainly on fish and squid rather than on the surface-dwelling krill favored by many other penguin species. As a result, emperors must frequently dive under the ice and into deep water in their search for food. I am fortunate in having had the opportunity of making diving studies of these birds. These were probably the first such studies of any penguin, previous investigations having dealt primarily with penguin reproduction on land.

The procedure used was the same as that I had already employed in

studying Weddell seals. An ice hole was cut well away from any other cracks or holes to which the diving birds might go. This forced them to return to our hole. A heated laboratory hut of sufficient size to provide researchers easy access to the deep sea below was placed over the hole. And an observation tower was lowered through the ice thirty feet away from the hut. The tower enabled us to sit about ten feet below the ice and observe much of the birds' diving activity. Although the six-foot-thick ice made it rather dark down there, the ice, in combination with the long winter night, suppresses plankton growth, and the result is perhaps the clearest surface water anywhere in the world. In some localities objects can be discerned underwater up to 600 feet away and meaningful light and dark areas can be distinguished at a distance of almost 1,000 feet. Under these circumstances, we released penguins, some wearing instrument packs, into the ice hole.

Because of the color pattern of the penguins, we lost sight of them at about 200 feet. Nevertheless, we did learn several interesting things from these experiments. By training some birds to swim between two holes spaced a known distance apart, we measured a maximum swimming speed of 5.2 mph, much slower than the illusion penguins give when maneuvering. We also discovered their acrobatic proclivities. I saw one bird virtually pinwheel on its wings and reverse swimming direction. The turn was so quick I could hardly follow it. The fastest ascent rate we measured was 400 feet per minute, an impressive figure considering the rapid pressure equilibration necessary if the ascent is made from a great depth. The longest dive in nearly 250 observations lasted eighteen minutes. This is considerably longer than the diving durations recorded for any other bird and longer than the dives of many marine mammals. The deepest dive measured was less than 130 feet, a surprisingly conservative figure probably influenced by our research



methods and the fact that the birds were diving singly.

When released in the ice hole, a bird would spend all of its time seeking other exits or trying to make one by using its stout beak as a battering ram. Therefore, I organized a trip to Cape Crozier to measure the diving depths of birds at the ice edge, where I was sure they were feeding and their dives would, accordingly, be different. I knew from previous trips to the Cape that birds departing from the rookery wait in groups at the ice edge, dive together, and after several dives, return. Taking advantage of this behavior, we placed depth recorders on twenty-five birds. This device consists of a capillary tube in which the interior is dusted with a water-soluble dye. Any compression is indicated by a ring in the capillary. The instrument, devised in the mid-1800s by Lord Kelvin, the British mathematician and physicist, was a major innovation in that it permitted ships to make soundings while under way, rather than having to stop and drop a weighted line.

While we waited for the birds to return to their rookery, we watched them dive in groups as large as twenty-five to fifty. Their dives were literally made under our feet. The sea was glassy and we could see the penguins swimming vigorously as they disappeared from sight below us. They surfaced several minutes later,



still in groups, breathing deeply in open-beaked gasps. On recovering our recorders, we were rewarded with a maximum depth measurement of 885 feet, probably the deepest dive ever recorded for a bird. (By comparison, according to the *Guinness Book of World Records*, the deepest dive made by a human being wearing scuba equipment is 437 feet.)

Impressive as these penguin statistics are, they pale alongside those of the Weddell seal, the other year-round resident of Antarctica, named for James Weddell, a British explorer who first collected specimens during his voyage to the Antarctic between the years 1822 to 1824. The species is large for seals; adults can exceed ten feet in body length and weigh more than 1,000 pounds. The chest and stomach are a mottled white and black or dark brown and the back is a uniform black or brown.

Weddells usually inhabit areas south of the Antarctic Convergence (the ocean boundary that separates the waters surrounding Antarctica into antarctic and subantarctic regions), although strays have been found as far north as South America, New Zealand, and Australia. The most northerly breeding ground is South Georgia Island, where a small number pup each year. Around Ross Island in McMurdo Sound, where my studies were made, several hundred pups are born from late September to early November—the antarctic spring. At birth the pups weigh about 55 pounds and are approximately 45 inches long. The mother provides

## The Breeding Cycle of Emperor Penguins

Birds begin arriving at most of the rookeries in late March—the end of the antarctic fall. (They arrive from thirty to forty-five days later at the more southerly rookeries such as at Cape Crozier.) Courtship, involving visual and vocal displays, begins immediately and from late May through the middle of June—wintertime—the birds lay their eggs. Females fast during the courtship and laying period and lose about 20 percent of their body weight. The female emperor lays only one egg and then departs for the sea to feed, leaving her male partner in charge of incubation.

For about two months, the males incubate the eggs on the tops of their feet under a flap of highly vascularized skin called an incubation patch, or pouch. This pouch promotes heat transfer and keeps the egg at 90° to 100° F despite winter temperatures known to dip

as low as -50° F. Males take no food during incubation, living on stored fat reserves, and lose up to 50 percent of their body weight during that period.

Females return to the rookery about mid-August, the time of hatching, to relieve the males: At hatching, the penguin chicks weigh just under one pound and are covered with a coat of down. For approximately the next six months—from the antarctic late winter through summer—until the time the chicks fledge, males and females take turns caring for and feeding the young.

By the time fledging ends, sometime between December and February, the young have become independent and can find their own food at sea. The independence of the young penguins leaves the parents free to go to sea themselves until March when they return to the rookery to breed again.

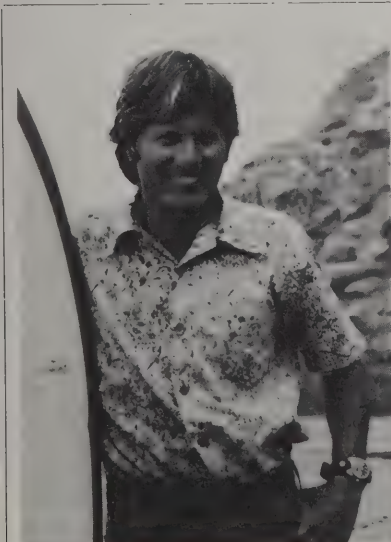
them with one of the richest of milks, sometimes containing over 70 percent by weight of fat and protein. On

this diet the pups gain weight rapidly, and after six to seven weeks, when they are weaned, they have gained as much as 200 pounds. The mother eats very little while nursing and endures a considerable weight loss of up to 300 pounds. She ends nursing by abruptly leaving the pup one day and not returning. After a few days of rau-

cous bleating—and perhaps even attempting to get milk from another mother—the pup begins to move farther and farther from its birthplace. At this time of year, December—which is antarctic summer—the fast ice (solid sheets of ice fastened to the shore) is breaking up, there is much open water, sea food is in abundance, the weather is relatively mild, and circumstances are ideal for these young diving amateurs. Only an occasional killer whale pack is likely to disrupt their tranquility.

As winter sets in, although most adults remain, the young Weddell seals and some adults leave the southern regions of Ross Island for parts unknown. Those that stay continue to dive and feed under the newly forming ice that rapidly thickens to several feet, reaming breathing holes through the thinner areas as required. A secure ice platform containing spaced breathing holes made by the seals offers almost unlimited research opportunities, and for several years, beginning in the late antarctic winter and early spring, I conducted studies of Weddell seals in order to learn what I could about their diving behavior and physiology.

Following a procedure later copied in investigating the emperor penguin, a seal was released from an isolated



“When in the presence of the emperor penguin in its natural surroundings, I am always struck by the majesty of the place and the animal,” says **Gerald L. Kooyman**, who has made eight field trips to Antarctica to study this bird and other animals native to the continent. Kooyman—an experienced scuba diver—received his Ph. D. in zoology and is an associate research physiologist at Scripps Institution of Oceanography in La Jolla, California. His specialty is the structure and function of the respiratory systems of aquatic vertebrates and their diving behavior. His effort is “to understand animals that spend most or all of their lives in a medium a thousand times more dense than ours.”



hole. Because of the animal's size, the process was a little more complex with seals than with emperor penguins. A seal was towed to the hut in a large enclosed sled. The sled was backed up against the hut door and then opened. The seal usually crawled directly into the hut, entered the ice hole right away, and began diving. But occasionally a seal did not enter the water for several hours and then we were obliged to share our hut with the animal for the evening or the night—which reminded us of the joke about where does a 500-pound gorilla sleep.

A seal's first dives are usually short and shallow as the animal familiarizes itself with the under-ice surroundings of its new location. Soon, either deep-feeding dives or exploratory dives are begun. I was worried initially that a seal might become confused and drown under the ice. But it quickly became apparent that the animals have superior diving abilities with regard to depth and duration and can find their way around underwater. While feeding, they would commonly dive to depths of 600 to 1,200 feet. These dives lasted from eight to fifteen minutes. The deepest dive measured was to the bottom of McMurdo Sound at a depth of 1,970 feet. This is one of the deepest dives ever recorded for a marine mammal.

Especially interesting were the seals' exploratory dives. Unlike the deep dives, which were made directly below our hut, in exploratory dives the seals swam a considerable distance away from the hut and the vital breathing hole and never descended deeper than 600 feet. Presumably, those exertions were attempts to find other seals or other breathing holes. Because of recording equipment the seals occasionally carried, we know something of the nature of these dives. The longest exploratory dive recorded lasted seventy minutes. This is one of the longest natural dives recorded for any marine mammal, although sperm and bottlenose whales have remained submerged for even longer periods after being harpooned. Long-lasting dives were rare, but dives of twenty to forty minutes duration were common. All of these forays took place at depths of less than 600 feet as the seals swam possibly up to six miles from one breathing hole to another.

My observations of seals convinced me that there is almost no



where in the Sound that they cannot reach. Any small break in the ice they can breathe through is likely to be found. Even in the most isolated areas, marine biologists making ice holes or scuba dives are likely to find a seal approaching from below.

The diving abilities of the emperor penguin and Weddell seal raise a variety of questions about how these animals function. For instance, what anatomical and physiological features enable the animals to withstand the enormous pressures they are exposed to when they dive deeply? And how are they able to hold their breath for so long? The most extensively studied aspect of the physiology of diving birds and mammals is the modifications that make extended breath-holds possible. Since breath-holding responses in both birds and mammals are similar, one explanation applies equally to both groups.

We know of two fundamental ways that enhance the capacity of animals to hold their breath. One is the increase of body oxygen stores; the other is the parsimonious utilization of those oxygen reserves. For example, the blood hemoglobin concentration of Weddell seals—and consequently the oxygen-carrying capacity of their blood—is 1.7 times greater than in humans. Similarly, the  $O_2$  carrying capacity of the emperor penguin is 1.6 times greater than that of the domestic chicken. Furthermore, the total blood volume of the Weddell seal on a per weight basis is twice that of man. (But the blood volume of penguins on a per weight basis is no different from that of chickens.)

The muscles of both penguins and seals contain a significantly higher concentration of myoglobin, an oxygen-binding molecule, than occurs in terrestrial birds and mammals. The net result is a larger total body oxygen store. However, the lungs of penguins and seals are not larger than those of terrestrial animals and contribute no more to the total oxygen store than the lungs of any other bird or mammal.

When penguins and seals dive, their large body oxygen stores are husbanded. This is accomplished by a major change in their blood circulation. Flow to tissues capable of periodic anaerobic or lowered metabolism, such as muscles, kidneys, or the gastrointestinal system, is decreased while flow to tissues of high aerobic and metabolic needs, such as the brain, are maintained. These flow changes are reflected in a lowered heart rate and cardiac output, which may drop to 10 percent of the predive level. The result is a significantly lowered consumption of oxygen during the dive and thus an ability to extend the breathhold.

Heart rates were measured during portions of Weddell seal dives. The usual method of measuring heartbeat rates is to place a positive and a negative electrode on opposite sides of the chest and connect them with three- or four-foot lengths of wire to a recorder. The recorder monitors the electropotential change that occurs within the body each time the heart muscles contract. We followed this conventional method, except that our wires were 200 feet long and had breakaway connectors. When the seal reached the end of the line, the connectors parted and terminated the recording until the next dive, when they could be plugged in again. This method permitted us to measure heartbeat rates during the entirety of some shallow dives and the early parts of deep and exploratory dives.

The recordings indicated that the degree of heart slowing depended on the type of dive. During shallow resting dives just below the ice hole, the heart rate dropped from a surface average of fifty-five beats per minute to a rate of twenty-five to forty. If the dive was deep, the rate dropped lower, and it was lowest of all on exploratory dives, when it sank to fifteen beats per minute. It seems quite logical that during the longest dives blood flow would be most restricted and oxygen stores be most slowly uti-



lized. The heartbeat rate, however, is believed to be autonomic, or involuntary, yet the drop took place so quickly, it almost seemed to anticipate the dive. One can only wonder how that is achieved.

When Weddell seals and emperor penguins dive to great depths, those portions of the body that are most affected by mounting pressure are gas-filled spaces because their volume must change considerably as the animal descends. The largest gas-filled space in the body is the respiratory system, consisting of the trachea, or windpipe, and the lungs. The respiratory system of the Weddell seal, however, is structurally very different from that of the emperor penguin. And the seal's lungs are also somewhat different from those of terrestrial mammals. The airway system in the seal, which is the transport system of air to the gas-exchanging alveoli, or air cells of the lungs, is more extensively strengthened than in terrestrial mammals. The extra support consists of cartilage, muscle, and connective tissue. Experimental evidence indicates that the added reinforcement insures that when the animal descends, its lungs compress differentially. The alveoli, being more compliant—that is, capable of readily changing shape—than the airways, compress the most and the gas within them is forced into the airways. Since at great depth many or most alveoli are collapsed, there is very little gas exchange between alveoli and blood and the gas is sequestered in the non-exchanging airways. That this collapse will also occur at shallow depths is assured by the seal's behavior. As the seal dives it exhales one-half to two-thirds of its lung volume.

A stoppage of gas exchange at depth means that oxygen stored in the lungs is unavailable for consumption. However, it is a small amount of the total body  $O_2$  store. More important is that nitrogen at high pressures is not taken up by the blood and accordingly does not expose the seal to decompression sickness—the bends—when the animal surfaces.

The penguin respiratory system is neither as well studied nor as well understood as that of the seal. It consists of several air sacs distributed throughout the body and connected to the lungs by conducting tubes. The air sacs have a far larger volume than the bird's lungs. When the penguin dives it inhales deeply and most of the



gas is stored in the air sacs. The volume of these sacs relative to body weight is up to eight times greater than the lung volume in the seal. The oxygen volume in the penguin's air sacs represents a large proportion of the bird's total body  $O_2$  store; the rest is in the blood and muscles.

Under experimental conditions, Adélie and gentoo penguins have been put through simulated dives at pressures equivalent to those at 230 feet. In these circumstances, gas exchange between air sacs, the lungs, and the bloodstream continued and the tissues were exposed to high nitrogen tensions. But the birds did not get the bends, perhaps because the exposure to high pressure was brief. These two species of penguin cannot hold their breath for more than five minutes, and under natural conditions they rarely dive for more than one or two minutes. Similar experiments have not been done on emperor penguins but it is likely that tests would yield analogous results since the respiratory systems of all three species appear to be similar. This makes the emperor penguin something of an enigma. It commonly remains submerged for five or ten minutes while diving to great depths, and it is not clear how the bird avoids getting the bends when it surfaces.

The final and most frequently asked question about aquatic polar animals is, How do they maintain their body temperatures in the frigid air and water? When the penguin chick hatches it is covered with a fluffy coat of down. When the seal pup is born it is covered with a long

fur called lanugo. The insulation of the penguin's down is only about one-half that of the fur coat of the arctic fox and the seal's lanugo is only about one-third as effective. These deficiencies, however, are not too important since adult plumage replaces the chick's down within a few months of hatching and the pup acquires another type of insulator one or two weeks after birth.

The tips of the feathers of the adult emperor penguin overlap like tiles on a roof, forming a waterproof shell, and the downy portion at the base traps a layer of air next to the body, conserving its heat. This plumage enables the bird to tolerate air temperatures as low as  $14^{\circ}\text{F}$  without making any effort to keep warm. That is no match for some arctic mammals whose thermoneutral zone extends to at least  $-60^{\circ}\text{F}$ , but the emperor penguin's plumage represents a compromise—it has to be effective in water as well as air, and the requirements for a water-repellent, streamlined coat are different from one functional in air only.

The heat conductivity of water is more than twenty times that of air. Measurements of the metabolism of Adélie penguins show that it increases to three times the resting rate after they enter water. Presumably, a similar increase is necessary for the emperor penguin because when it remains inactive after entering the sea, it soon begins to shiver. In contrast, the adult Weddell seal does not rely on its pelt for insulation, but rather on a thick layer of subcutaneous blubber that begins to develop immediately after birth. This type of insulation, which conducts heat at about the same rate as asbestos, is so effective that the seal can rest comfortably in  $28^{\circ}\text{F}$  seawater. When a severe storm occurs, rather than be blown by winds that can achieve hurricane force and pelted with ice and snow on the surface, Weddells take shelter in the water until the storm subsides.

Two questions I have not answered are, Why don't deep-diving penguins suffer from decompression sickness on surfacing? And how do emperor penguins and Weddell seals navigate under the ice? On future visits to Antarctica, I plan to look into these matters, as well as other aspects of diving behavior and physiology, in the continuing search to learn how these animals function in one of the most hostile environments on earth. □



## CRREL Mission - Past, Present, Future...

### Related to Far North Strategic Defense, Many Civil Programs

Strategic importance of the far north to national defense interests of the United States is strongly related to the mission of the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, although CRREL has been and is basically a civil engineering research organization.

CRREL scientists, engineers and specialists, in an interdisciplinary approach to the planning and conduct of over-all research, development, test and engineering programs, focus effort in cold regions type problems.

Quoting from the official mission statement, CRREL is concerned with problems "...applicable to U.S. Army needs in those geographic areas of the world where cold presents a severe problem at least one year in 10..."

Geographically, this includes the northern half of the United States and on to the north, as well as most of Eurasia where, throughout history, winter has been a major factor in military operations.

Technological areas of concern to CRREL primarily include road and airfield pavement structures, foundations, building structures and utilities systems for cold regions.

Applied research programs are supported by a strong basic research effort centered on fundamental properties and behavior of snow, ice and frozen ground under varied conditions. Long recognized quality of performance within this specialized area has earned CRREL's staff a highly valued international reputation.

CRREL was established at Hanover in 1961 through the merger of two U.S. Army Corps of Engineers research organizations. One was the Arctic Construction and Frost Effects Laboratory (ACFEL), formed at Waltham, MA, during World War II. The other laboratory was the Snow, Ice and Permafrost Research Establishment (SIPRE) which was located at Wilmette, IL, in 1949.

ACFEL was created to conduct research for solving engineering and construction problems encountered by the Army Corps of Engineers in Alaska and Canada.

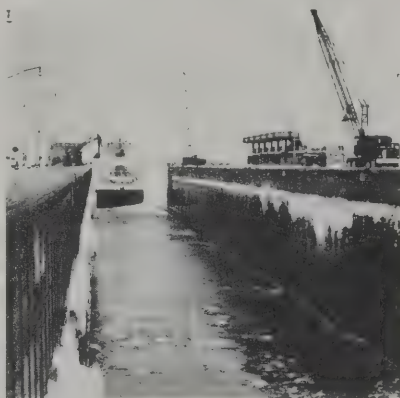
Formation of SIPRE was induced by the Cold War - the realization that the arctic region had assumed great strategic significance in the defense of North America from attack by aircraft or missiles following Great Circle routes.



Engineer Battalion, Vietnam; senior engineer adviser, IV Corps; executive director, U.S. Army Engineer Institute for Water Resources, Alexandria, VA. He has been awarded the Legion of Merit, (OLC) Bronze Star, Army Commendation Medal (3OLC).

COL ROBERT L. CROSBY has been commander and director of the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL) since Aug. 1, 1973. Formerly Secretary, U.S. Army Engineer School, he is a 1953 graduate of the U.S. Military Academy, West Point. COL Crosby received a master of science degree in civil engineering from Iowa State University. He is a graduate of the U.S. Army Command and General Staff College and the Air War College.

COL Crosby's assignments have included service with the 503d Engineer Group in Korea; as company commander, 271st Engineer Battalion and 9th Engineer Battalion at Fort Lewis, WA; assistant professor, Military Science, Northeastern University, Boston; assistant resident engineer, U.S. Army Engineer District, Alaska; the Officer Personnel Directorate; Office of the Assistant Secretary of the Army (M&RA); commander, 92d



APPLICATION of ice-phobic coatings, water jets, and large chain saws for cutting ice, are among methods being studied at CRREL to prevent ice buildup which restricts shipping seasonally in cold climates.

This realization led to the construction of the Distant Early Warning Line extending along the rim of the Arctic Basin from northwestern Alaska, through arctic Canada and Greenland. Research performed by ACFEL and SIPRE played a highly important role in making the DEW Line system a reality.

Continuing importance of the far north to the U.S. national defense interests became increasingly apparent during the 1950s, pointing to the need for sustained research in cold regions science and engineering.

The U.S. Army Corps of Engineers responded by developing a plan to consolidate ACFEL and SIPRE activities at a new site having a climate cold enough to permit local research in the field during the winter months. An extended site selection study considered numerous possible locations, including the Rocky Mountain area as well as Upstate New York and New England.

Dartmouth College eventually offered to provide a site in Hanover on a long-term lease basis. Dartmouth had an extensive library collection of original documents on polar exploration to support a proposal that there be close interaction between the college and the planned laboratory for mutual benefit.

In response, the Army accepted the site and a unique laboratory facility was designed and

constructed during 1959-61. With few exceptions, the professional staffs of ACFEL and SIPRE relocated when the new CRREL building was ready for occupancy late in 1961.

The Army Corps of Engineers' first major return on investment on cold regions research was the early development of basic information on the physical and engineering properties of snow, ice and frozen soil. This knowledge permitted timely construction of the DEW Line system in the mid-1950s.

A field research station was established near Fairbanks, AK, when ACFEL was formed because of permafrost (permanently frozen ground) in that area. Research was conducted on various types of foundations in permafrost.

Results paid off the investment many times over in the design and construction of the White Alice Communications System and the Ballistic Missile Early Warning System at Thule, Greenland, and Clear, AK, along with the DEW Line.

The SIPRE investment in ice and snow research provided a capability to operate heavy-cargo aircraft from both sea and lake ice runways - a capability essential to expedited construction of the DEW Line. Two unique radar sites were also constructed on the interior of the Greenland ice sheet, which averages more than 3,000 meters in thickness.

Considerable additional snow and ice research



CRREL is developing snow-load criteria that will lead to more effective and economical snow-load protection for private homes and U.S. industrial areas.



CRREL is examining methods to control and prevent ice jams that result in flooding of rivers and damage to towns (shown above).



was conducted on the Greenland Ice Sheet prior to the Camp Century operation in northwestern Greenland during the 1950s and early 1960s. Camp Century was an under-snow Army installation constructed in the ice sheet 240 kilometers from Thule. Valuable cold regions technology information was gained from research done at Camp Century and at Camp TUTO, located at the edge of the ice sheet in the vicinity of Thule.

An interesting turn of events for CRREL resulted from the Army-wide reorganization in 1962. When the Army Materiel Command was formed, two Corps of Engineers laboratories, CRREL and the Engineer Research and Development Laboratory (renamed MERDC), were transferred to AMC.

CRREL operations in Greenland were phased down and terminated. Concurrently, Army involvement in Vietnam was increasing rapidly. Part of the impact on CRREL was a de-emphasis on "polar" research and a shift was made to cold regions problems encountered at lower latitudes.

Requests for CRREL expertise and capabilities for application to Vietnam-related problems included innovative methods for mine and tunnel detection. The shift away from cold regions research emphasis continued during the late 1960s - culminating in the renaming of the laboratory, for a brief time, as the U.S. Army Terrestrial Sciences Center.

Shortly following this period it became apparent at the Washington level that the capabilities and output of CRREL correlated more closely with the Corps of Engineers mission than that of AMC, and that there was a continuing need for cold regions research. The



CRREL researchers observe and assess construction and operation of the Trans-Alaska oil pipeline, in order to improve basic understanding of the interaction of man's activities with permafrost and cold regions.

laboratory was returned to the Corps control in August 1969. Corps laboratories reported to the Chief of Engineers at that time through staff directorates.

Under this arrangement, CRREL reported to the Director of Military Construction, as did the Construction Engineering Research Laboratory (CERL), Champaign, IL. The Engineer Topographic Laboratory, Fort Belvoir, VA, reported to the Military Engineering and Topography Directorate.

The Waterways Experiment Station (WES), Vicksburg, MS, and the Coastal Engineering Research Center (CERC), Fort Belvoir, VA,

reported to the Civil Works Directorate.

CRREL's work thus tended to reorient on military engineering and construction problems in the cold regions, although the Army Materiel Command continued to support basic and applied research related to cold regions environmental constraints.

Subsequently, it became apparent that CRREL could and should conduct research related to the Civil Works mission of the Corps of Engineers, including responsibility to the Congress for development of the nation's harbors and navigable waterways.

The Corps of Engineers Civil Works mission was later expanded to include responsibilities for flood control and water resources development. Recent laws and court decisions have added authority over many proposed activities which could adversely impact on water quality and the wetlands environment.

Accordingly, with Civil Works as well as Military Construction support, CRREL initiated a major research program on the treatment of wastewater effluents by disposal on land. The Corps is required to have the engineering technology available to assure that Army and Air Force installations will meet future water-quality standards established by the Environmental Protection Agency.

Land treatment must be considered, along with other means, for the advanced treatment of wastewater which may be required to meet new water quality standards. The Corps is further required by law to be available as a consultant to state and local governments on land treatment technology.

Responsively, the Corps program has

(Continued on page 18)

## CRREL Drilling Program...

### Impacts on NSF Ice Sheet Projects

U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) investigators have played an important role in the National Science Foundation's Greenland Ice Sheet Program (GISP) and Ross Ice Shelf Project (RISP) for a number of years.

During research in technology for excavating snow, ice and frozen ground, they developed an electrically heated, cable-suspended thermal drill used in the initial penetration of the Greenland ice sheet in the 1960s.

A reconditioned cable-suspended electromechanical rotary drill modified in 1964 was used to penetrate to a depth of 1,390 meters (4,287 feet) to reach bedrock at Camp Century in northwest Greenland.

Analysis of this ice core has revealed the record of more than 120,000 years of climatic change, including the entire last ice age (Wisconsin) which was triggered some 75,000 years ago. It terminated abruptly about 10,000 years ago.

The CRREL thermal drill has been used to take several other Greenland ice cores of about 400 meters and to retrieve the upper portion of a 2,200-meter-deep core from Byrd Station in Antarctica.

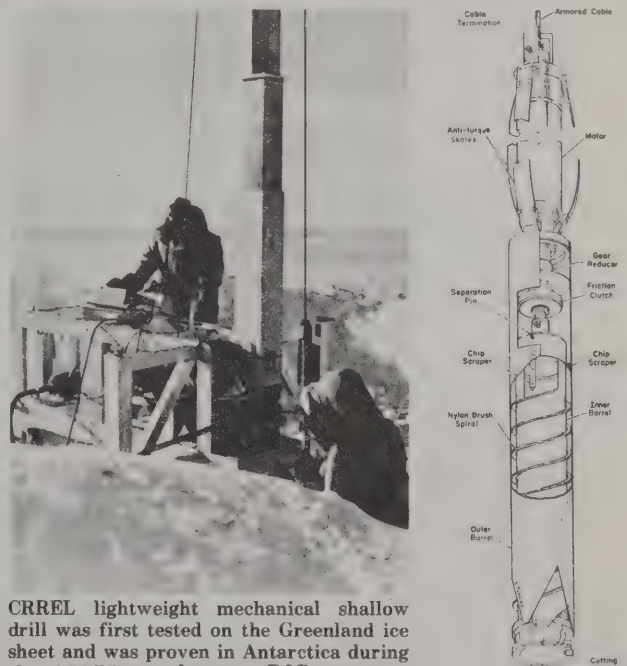
Recent efforts in the drilling program have been focused on developing a mechanical wire line drill which will be significantly faster than the thermal rig for deep drilling. CRREL's attention has been centered on the development of a lightweight mechanical shallow drill capable of 100-meter depths and movable in ski-equipped aircraft smaller than the C-130.

The shallow drill was first tested on the Greenland ice sheet and was proven in Antarctica during the 1974-75 austral summer. Recovery of a 101-meter core under the geodesic dome at the South Pole was one of the first scientific achievements completed at NSF's new Amundsen-Scott Station at the South Pole.

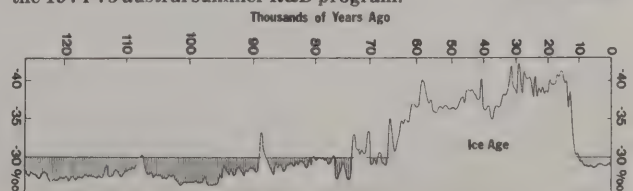
The shallow drill rig has potential for developing a medium-depth capability which could prove most valuable in the study of atmospheric pollution and climatic change during recent decades and centuries.

Strong scientific interest exists in the causes of climatic change. In a world with an exploding human population, there is a very real need to develop means for predicting climatic shifts and their international impacts.

CRREL continues to play an important role in this work, which was initially funded by the Army but is now sponsored by the National Science Foundation. Past and future efforts by CRREL are expected to provide powerful tools for unraveling the mysteries of climatic change.



CRREL lightweight mechanical shallow drill was first tested on the Greenland ice sheet and was proven in Antarctica during the 1974-75 austral summer R&D program.





## CRREL Mission — Past, Present, Future . . .

(Continued from page 17)

progressed to the stage of preparing, in a joint effort with the EPA, a manual for the planning and design of land treatment systems. This research effort obviously is of long-term benefit not only for the military community but for the entire nation.

The Corps' research and development management structure was revised in 1974 as a result of a study directed by the Chief of Engineers. A small Research and Development Office was created and authorized to report directly to the deputy chief and the Chief of Engineers LTG William C. Gribble Jr. Designated as Corps Laboratories, WES, CERC, ETL, CRREL and CERL were authorized to report to the Chief of the Research and Development Office William B. Taylor Jr.

A number of management actions were subsequently taken with the objective of forming a more cohesive Corps of Engineers R&D program having a clearly defined thrust relating to principal mission areas.

Concurrent with this reorganization was the establishment of the Facilities Engineering Directorate in the Office of the Chief of Engineers. Corresponding adjustments were made within the Corps R&D community to provide support appropriate to the higher priority given to facilities engineering.

What does the future hold for CRREL? Part of that answer relates to the fact that Western

Europe is a primary area for military contingencies and that cold can present the U.S. Army with many serious problems in that environment.

CRREL's research program accordingly will continue to address the myriad of cold problems which could be encountered in Europe. An example of current interest is the phenomena of helicopter icing. CRREL is drawing on its store of knowledge of the fundamental properties of ice in search of new and perhaps greatly improved techniques to prevent or acceptably control helicopter icing.

Another area of increasing attention is termed "Ice Engineering." A study has shown that average annual damages due to ice in the nation's waterways total about \$200,000,000. This problem relates primarily to the Civil Works function but should have important spinoffs of value to military engineering. The program is designed to find ways to reduce these costs.

An Ice Engineering Laboratory, a major addition at CRREL, will soon be under construction and will be dedicated to finding solutions to many types of anticipated problems.

Some major categories are: Extending the winter navigation season in the Great Lakes; ice damage to structures in winter waterways; inefficiencies in the operation of locks for ships and barges; flooding due to ice jamming in northern rivers; reduction of hydroelectric power production capacity or damage to hydro

power facilities.

Another influence on CRREL's future will surely be development in Alaska, triggered by current petroleum discoveries and accelerated in the future by the development of known and yet-to-proven reserves.

Petroleum development will not occur in a vacuum. It will be accompanied by the development of transportation systems, of other natural resources, and general social and economic growth.

Alaska is in the process of assuming a new and different strategic significance to the nation that will impact on National Security Policy and on the Corps of Engineers responsibilities to provide means to support future military developments in Alaska.

Civil Works responsibilities of the Corps will also be affected. Water resources development, flood control, rivers and harbors work and offshore developments all have implications for research which should be performed by CRREL to meet the Corps' future needs in Alaska.

Furthermore, petroleum search and development activity is not by any means limited to Alaska; it includes the entire rim of the Arctic Basin. Thus it will become international in nature, involving not only the interests of the U.S. but also of Canada, Norway, Denmark and the Soviet Union.

This situation should trigger a revived national interest in arctic research and a parallel increase of international interest and support. CRREL, it is clear, will have an important role to play in these areas as the future unfolds.

ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE

MARCH-APRIL 1976

## 2 Climate Experts Decry Predictions of Disasters

By WALTER SULLIVAN

The New York Times

BOSTON, Feb. 21—Two authorities on climate change have termed irresponsible recent predictions of an impending ice age or other climatic disaster. They also said that any global effects of man-made air pollution on the climate to date remained obscure.

One is Dr. Helmut E. Landsberg, director of the Institute of Fluid Dynamics at the University of Maryland and former director of the Office of Climatology in the Weather Bureau, now called the National Weather Service. His views were expressed here yesterday at the annual meeting of the American Association for the Advancement of Science.

The other is Dr. J. Murray Mitchell Jr., climatologist of the Environmental Data Service of the National Oceanic and Atmospheric Administration. His views are set forth in the newly published proceedings of a conference on the subject at the University of North Carolina last year.

Dr. Landsberg presented data showing large year-to-year variations in precipitation and

temperature for various regions of the world, but no significant trends over the last century and a half. He also said there was "absolutely no evidence" of an effect on climate by industrial air pollution.

Both men cited as examples of foolish forecasting, ominous predictions of an "ice blitz" based on the unusually extensive snow cover of northern regions in the early 1970's. The trend proved short-lived.

"The media," said Dr. Mitchell, "are having a lot of fun with this situation. Whenever there is a cold wave, the seek out a proponent of the ice-age-is-coming school and put his theories on page one," he said. "Whenever there is a heat wave," he added, "they turn to his opposite number"—someone willing, for example, to predict "a kind of heat death of the earth."

The onset of a new ice age "is an unknown number of centuries or millenia away," Dr. Mitchell continued. Conceivably the trend has already begun, but could long remain well disguised "amid the more rapid

fluctuations of climate."

He cited atmospheric pollution by carbon dioxide, smoke particles, aircraft exhaust gases and fluorocarbons as potential long-term threats to the cli-

mate. But he predicted that "our long-range climate problems will be ordinary and manageable, rather than extraordinary and unmanageable."

## Fur Seal Group's Decision Disappoints Oceanic Agency

Anchorage Times

WASHINGTON — The National Oceanic and Atmospheric Administration is disappointed that delegates to the Interim Convention on Conservation of North Pacific Fur Seals have not adopted U.S.-proposed management concepts.

The group has agreed to recommend to their governments that the convention be extended for another four years. But the delegates refused to adopt the concept of optimum sustainable population that is part of the U.S. Marine Mammal Protection Act.

The U.S. wants consideration to be given to the aesthetic and recreational value of the fur seals and the necessity of maintaining the health and stability of the marine ecosystem.

The Interim Convention on Conservation of North Pacific Fur Seals was entered into in 1957 by the U.S., Canada, Japan, and the Soviet Union, to regulate the harvest of fur seals in the North Pacific.

About 80 per cent of the northern fur seal resource is associated with the Pribilof Islands of the U.S., located off the coast of Alaska.



# Geologists Find Snow Rarely Fell in Ice Age

By WALTER SULLIVAN

The New York Times

Contrary to longstanding assumptions, it apparently snowed very little at the height of the last ice age, 18,000 years ago.

This has been indicated by an ambitious effort by scientists from a number of institutions to reconstruct the global climate of that period.

It appears that when the ice sheets began to form, some 80,000 years ago, they grew rapidly. But as they spread, their effect on atmospheric circulation was such that the world became increasingly arid.

As one participant in the scientific project put it yesterday, perhaps within the ice sheets growth patterns were the seeds of their own destruction.

The project is known as CLIMAP, for Climate Long-Range Investigation Mapping and Prediction. Its headquarters is at the Lamont-Doherty Geological Observatory of Columbia University. The findings, published as two reports in the March 15 issues of the journal *Science*, cover only one stage of the project, initiated in 1971.

No attempt is made to assess what caused the ice ages or what the future may bring. The findings are a "snapshot" of the world as it was 18,000 years ago, showing how circulation and temperature patterns of the air and oceans differed from those of today.

Another "snapshot" is planned of the world as it was between the last two ice

ages, 120,000 years ago, when the world was warmer than today. These and other projected "snapshots" should help explain why the change took place.

This new line of attack, according to Dr. John Imbrie, professor of geology at Brown University and a former CLIMAP director, is for the first time converting historical geology into a mathematical science.

The climate of 18,000 years ago has been reconstructed from evidence in the sediments (on land and at sea) and in the Greenland ice layers laid down at that time. Pollen reveals the contemporary vegetation of a region and hence its climate. The remains of small surface-dwelling sea animals show how warm surface waters were. Deep-dwellers reveal how frigid lower layers of the sea became.

## A Major Surprise

One of the major surprises has been the limited cooling of the world oceans during the ice age. On the average the temperature was only 4.1 degrees Fahrenheit lower than today. Some areas cooled more. According to Dr. Imbrie, it appears from samples drilled from the Greenland ice that in the last 120,000 years the climate was never much colder than 18,000 years ago.

Typical of the great changes that took place was a major southward displacement of the Gulf Stream as cold water be-

came dominant north of a line between the Carolinas and Spain. Ice piled up in east-central Canada to a depth of 9,500 feet.

Another surprise finding, Dr. Imbrie said, was that as the ice retreated in most of North America, it continued to advance in Washington and Oregon, not reaching its maximum advance until 14,000 years ago.

It has long been assumed that the most important ingredient of an ice age was heavy snowfall. Yet the study has shown that global precipitation 18,000 years ago was 15 percent lower than today. Stable low-pressure systems that would have produced heavy snows seem to have been far removed from the ice sheets.

This, it was noted, should not be so surprising for there is very little precipitation in the heart of Antarctica today. The lofty ice sheet there makes for very dry weather, and when ice covered large northern areas as well, the whole world was dry, with the apparently local exceptions of the rains that filled Great Salt Lake to brimming and moistened parts of North Africa in the "pluvial" periods.

The Greenland ice samples show rapid accumulation when the ice age was beginning and very little thereafter. It may be that only along the advancing front of the ice was there sufficient snowfall to feed it significantly.

One proposal by the CLIMAP group is that the marked cooling, by more than 10 degrees, of equatorial surface waters, caused by the upwelling of frigid waters, may have had a major effect on world climate. The warm water of that region today is a major source of evaporated water in the at-

mosphere.

Dr. Theodore C. Moore, current CLIMAP director, noted that while oceanic cooling was moderate the changes on land were substantial. The CLIMAP study has assumed that sea levels dropped almost 300 feet in the ice age, exposing a broad land bridge between North American and Siberia. But ice in southern Alaska and virtually all of Canada still blocked human access to the Americas.

The attempt to model the former climate was by Dr. W. Lawrence Gates, director of the Climate Dynamics Program of the Rand Corporation in Santa Monica, Calif. Other simulations have been carried out at the National Center for Atmospheric Research in Boulder, Colo., and at the Fluid Dynamics Laboratory in Princeton, N.J.

The latter is also testing the hypothesis that cyclic changes in the earth's orbit and spin axis alter the angle at which sunlight hits high latitudes sufficiently to trigger periodic ice ages. Of the many ice age theories that one now is perhaps the most popular.

## Polar Bear Pact Goes Into Effect

Agence France-Presse

MORTES, Switzerland, May 26 The first international agreement for the protection of Polar bears has come into effect, the World Wild Life Fund announced here today.

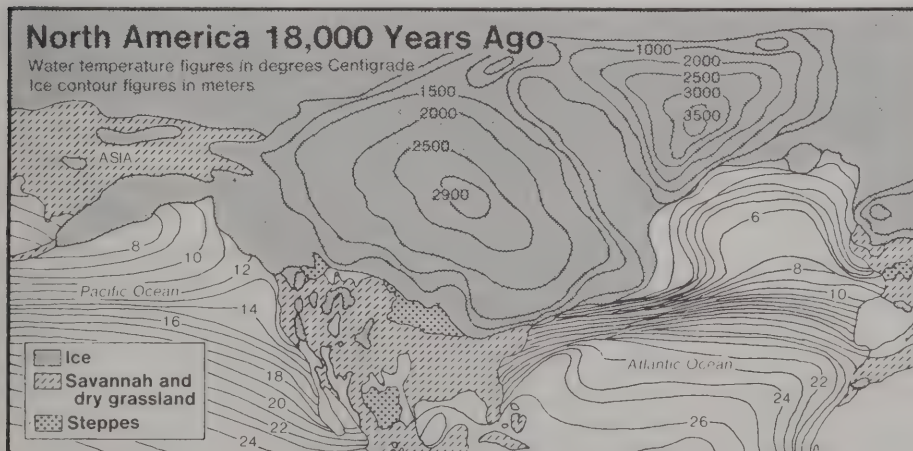
Three of the five countries surrounding the polar regions, Canada, Norway and the Soviet Union have ratified the agreement signed in 1973, Denmark and the United States will ratify it shortly, said the Fund.

The agreement "forbids the hunting, killing or capture of polar bears, except for scientific ends, in the interests of conservation or that of the indigenous population." The Fund estimates the polar bear population at 20,000.

WASHINGTON, May 19 (AP)

Alaska's historic preservation officer, Russell W. Cahill, has been awarded a \$15,000 grant to dig and investigate the oldest migratory route from Siberia to North America.

Announcement of the grant for the Dry Creek archaeological project was made Thursday by the park service's Office of Archaeology and Historical Preservation in Washington.



The New York Times/March 18, 1976

From evidence on land, beneath the sea and in Greenland ice, the climate at the height of the last ice age has been reconstructed by participants in the CLIMAP project. Ice covered almost all Canada. The Gulf Stream was pushed far south.



# CHANGE OF COMMAND CEREMONY OF THE NAVAL SUPPORT FORCE, ANTARCTICA 4 JUNE 1976

## Incoming Commander

CLAUDE H. NORDHILL

CAPTAIN, U. S. NAVY



Captain Claude H. Nordhill, U. S. Navy, comes to the U. S. Naval Support Force, Antarctica, from the U. S. Naval War College, Newport, Rhode Island. He is a native of Spokane, Washington, and entered the Navy as an Aviation Cadet in May of 1952. Upon completion of flight training he served in Alaska, Hawaii, and Japan while attached to Patrol Squadron Twenty-Eight (VP-28).

Following a three-year tour as a flight instructor in Hutchinson, Kansas, Captain Nordhill attended the University of Washington. He then was assigned to Patrol Squadron Four (VP-4), Naha, Okinawa. From 1962 to 1964 he served as Assistant Navigator and Senior Watch Officer on board the USS Ranger (CVA-61). In 1964 he attended the Naval War College as a student at the College of Naval Command and Staff. In 1965 he commenced a two-year tour of duty with the Joint Chiefs of Staff in Washington, D. C.. During the Vietnam conflict he served in Observation Squadron Sixty-seven (VO-67) in Southeast Asia. He then returned to the Naval War College for ten months as a member of the faculty.

Captain Nordhill has served previously in Operation DEEP FREEZE. He was assigned to Antarctic Development Squadron Six (VXE-6) during DEEP FREEZE 70, 71, and 72, when he served as the Squadron's Operations Officer, Executive Officer, and Commanding Officer, respectively. Upon completion of his tour with VXE-6 he was assigned to the Naval War College as a student at the College of Naval Warfare. After his graduation in 1973 Captain Nordhill was assigned to the faculty of the War College as a Professor of Strategy and Policy, and served in this capacity for two years. In 1975 he assumed duties as Director of Support Services and Conference Secretariat at the College. He held that position until his present assignment as Commander, U. S. Naval Support Force, Antarctica.

Captain Nordhill has attended Willamette University and holds a Bachelor of Arts Degree in Political Science from the University of Washington. He also has earned a Masters Degree in International Affairs from George Washington University. He has been awarded two Air Medals, the Joint Chiefs of Staff Commendation Medal, three Navy Commendation Medals with the Combat V, and the Navy and Meritorious Unit Commendations.

Captain Nordhill is married to the former Joy Jean Brisben of Jamestown, North Dakota. They have one son, Jimmy.

## PAST COMMANDERS

Rear Admiral George J. Dufek  
Feb. 1955 - April 1959

Rear Admiral David M. Tyree  
April 1959 - Nov. 1962

Rear Admiral James R. Reedy  
Nov. 1962 - April 1965

Rear Admiral Fred E. Bakutis  
April 1965 - Feb. 1967

Rear Admiral J. Lloyd Abbot, Jr.  
Feb. 1967 - June 1969

Rear Admiral David F. Welch  
June 1969 - July 1971

Captain Harry W. Swinburne, Jr.  
July 1971 - August 1971  
August 1972 - Sept. 1972

Rear Admiral Leo B. McCuddin  
August 1971 - August 1972

Captain Alfred N. Fowler  
Sept. 1972 - June 1974

Captain Eugene W. Van Reeth  
June 1974 - June 1976



U.S. Navy

LC-130F 148320 lands at McMurdo Station on 26 December 1975. The airplane was the first of two recovered from dome C during the 1975-1976 field season.

At its 178th meeting, the National Science Board, chaired by Norman Hackerman, noted with great pleasure the recent reports of the recovery of two damaged LC-130 airplanes from East Antarctica, and acknowledged this effort by passing the following resolution:

"Resolved, that the National Science Board expresses congratulations and appreciation to the commander, Naval Support Force, Antarctica, and to all the organizations and personnel involved in the successful recovery of two damaged LC-130 aircraft from the polar plateau in East Antarctica. Members of the board are aware of the most difficult conditions under which the air-

craft repairs were undertaken and anticipate that this remarkable achievement will be recognized as a major feat in aviation and antarctic history."

Robert H. Rutford, head of the National Science Foundation's Office of Polar Programs, telegraphed the resolution to Captain Eugene W. Van Reeth, Naval Support Force commander, adding, "All of us in the Office of Polar Programs join the National Science Board in passing on our congratulations for this tremendous effort. You can feel proud of your accomplishment with the knowledge that you have recovered and returned to use valuable national assets."

## Exchange scientist opportunities

The National Science Foundation is accepting applications from U.S. scientists in biology, biomedicine, geology, geophysics, glaciology, meteorology, and upper atmosphere physics for a year of research at one of the Soviet Union's antarctic stations

beginning in November 1976. Salary and costs of field research, data analysis, and travel are fully covered. Competence in the Russian language is desired.

Before submitting a formal proposal, applicants are encouraged to contact Walter Seelig, Office of Polar Programs, National Science Foundation, Washington, D.C. 20550 (telephone: 202/632-4078).

Gerald E. Reilly, Jr., a Coast Guard seaman aboard USCGC *Glacier*, was electrocuted while standing watch on 22 January 1976 in the ship's boiler room at 70°25'S. 137°40'W., in the western Amundsen Sea.

*Glacier* was en route from McMurdo Station to Palmer Station, on the Antarctic Peninsula,

at the time of the accident. The icebreaker returned Mr. Reilly's remains to McMurdo for air transport to the United States.

Mr. Reilly, of Independence, Missouri, was born on 2 August 1956. He was the 43rd U.S. fatality in the Antarctic since 1946.

ANTARCTIC JOURNAL



## Morley Spent Year in Antarctica

Jan. 6

Bruce Morley, 27, thinks this Nebraska winter is a piece of cake.

That's because he returned last month from the South Pole, where winter bottomed out at 103 degrees below zero.

On a real balmy summer day down there, it might get as high as zero.

Morley is a member of the very exclusive 300 Club. Its members have sweated out a 200-degree sauna and then dashed out nude (except for shoes) into the antarctic cold and its temperature of at least 100 degrees below zero.

"Your hair turns to frost immediately," Morley said, "and it certainly breaks the monotony."

### One of 17

Morley was one of 7 support personnel and 10 scientists who spent a year at the South Pole, conducting various research projects.

Morley, a graduate student at the University of Nevada at Reno, spent the year gathering data about the formation and vertical profile of ice crystals, the most common form of precipitation in Antarctica.

He is a Chadron State College physics graduate. He sent his master's thesis out of Antarctica on the last plane out before winter began there in March. He received his degree in August.

Summer at the South Pole runs from November through February. Winter is from May through September. Winter includes four months of total darkness with a month of twilight on either end of the period. In summer, it's light all the time.

### Lived in Dome

Morley lived inside a 52-foot-high geodesic dome in which it

was only about 20 degrees warmer than it was outside. Inside the dome were three buildings.

Each researcher worked independently. A 19-year-old cook provided the food, and a 27-year-old doctor from the University of Oklahoma, also doing research, served as the crew's physician.

Morley said the most serious physical problem was encountered by a man who had several appendicitis attacks, which were controlled with drugs.

Persons applying for work on the project were given both physical and psychological examinations before they left. Even so, three phased out early, two were replaced, and a fourth stuck it out for the year but caused some "interpersonal problems" for the rest of the crew.

For fun, the men, aged 19 to 50, sledged off the dome, watched movies, drank wine, read and, of course, qualified for the 300 Club.

Did they miss female companionship?

"Well, there weren't any there," Morley said.

Morley made more than 1,000 photographic slides, among the most beautiful the southern lights. A paper on his ice crystal research is expected by the National Science Foundation in about six months.

Other members of Morley's group plotted ice drifts, recorded earthquakes and measured the oscillation of the earth's core.

One of the big days of the year was celebrated when the first plane flew in after the long winter. It carried mail, fresh fruits and vegetables. "Green onions! Heartburn never felt so good," Morley said.

Morley said he was homesick at times, "but you get over that." He said he spent a lot of time asking: "What am I doing here?"

### Great Opportunity

But he recognizes it as an opportunity he won't get again. He'd like to go back — but not for a whole year.

The \$10,000 stipend he received went a long way, since he received his food, housing, most of his clothes and there

# There's no need for women's lib down here

Women serving with the United States Navy in Antarctica have not been relegated to junior roles.

In some cases women head departments and divisions in the navy's Antarctic programme.

Ensign Becky Hohman, 24, from Palatine, Illinois, the consolidated mess and special services officer for Naval Support Force, Antarctica, is one of these.

A consolidated mess officer is the overseer of clubs and messes at naval installations, and the special services officer is one who is responsible for the troops' recreational off-duty welfare. In short, Miss Hohman is responsible in a large part for the morale of the support force.

In such an isolated environment, recreational outlets are a positive factor in the morale of personnel.

Her responsibility spans 2400 miles, from New Zealand to McMurdo Station. She is in control of seven clubs, two package stores, and two separate special services complexes.

Between Christchurch, New Zealand, where the United States operates a small staging area, and McMurdo Station she employs some 50 full and part time people.

She considers the significant number of women who have served in Antarctica "have served well."

Aerographer Third Class

June Rice, 19, of Marcellus, New York, works a "12-hour-on 12-hours off job, typing at a teletype, taking weather observations, and plotting weather maps."

She appreciates the navy's educational opportunities. She attended college during previous tour in Washington, DC. The shy and attractive petty officer has been contemplating applying for a commission now that the navy is accepting women at the U.S. Naval Academy at Annapolis.

### TASK FORCE

Thirteen women have worked with the U.S. Navy's Antarctic Support Programme as members of Task Force 199 during Deep Freeze 76. Of these, two are civilians.

The navy woman's Antarctic role began during Deep Freeze, 1974 when the first woman officer was assigned to Operation Deep Freeze. In Deep Freeze '75, two additional women officers, were assigned and the number has steadily risen.

Seven enlisted, four officers, and two civilian women have been totally integrated into the daily routine, and work in such fields as medicine, administration, meteorology, communications, and supply.

were no stores to spend the rest.

A Nebraska wind chill index of 10 degrees below zero seems rather pleasant to Morley. He remembers wind chill index

readings of 185 degrees below zero.

Morley is the son of Mr. and Mrs. Robert Morley, 420 Lyncrest Dr.

## Holed Tanker Reaches Port

CHRISTCHURCH, New Zealand, Jan. 25 — The American tanker Maumee arrived safely at Antarctica's McMurdo Sound today with gaping holes on both sides of its bow.

The ship, carrying 4.25 million gallons of fuel for Antarctic research stations, was gorged when it hit ice Thursday.

## British Ship Back at Sea After Argentine Challenge

PORT STANLEY, Falkland Islands, Feb. 21 (Reuters)—A British research ship has left this port to resume a scientific program that was broken off earlier this month after an Argentine destroyer fired shots across the bow of the research vessel. The British ship's commander, Capt. Philip Warne, said that his Government had assured him of the safety of

his ship, the *hackleton*, and its crew. The *Shackleton* is bound for Antarctic waters.

The incident, on Feb. 4, arose from Argentina's long-standing claim to the Falkland Islands, known to Argentina as the Malvinas. The Argentine Government says the *Shackleton* took refuge in Port Stanley after she was challenged by the destroyer *Almirante torri*. Britain says the ship was heading for port and merely refused to alter course.



## Soviet Paper Regrets 1867 Sale of Alaska

The New York Times

MOSCOW, May 20—The Soviet newspaper Trud today deplored the 1867 sale of Alaska to the United States as "the most disadvantageous deal in the entire history of Czarist Russia."

The remark was published on the paper's back page in response to a letter from a reader in Kiev who wanted to know "who of the Russian seafarers first landed on the shores of Alaska," and why was it sold to the U.S.A. and for what price?"

The paper said that Captain Chirikov first landed on Alaskan shores in 1741, that the Russians opened up the peninsula in the late and early 19th century, but then after the Crimean war had insufficient strength to defend its settlements in North America.

"Possession of Alaska gradually led to conflicts with England and the U.S.A.," Trud wrote. "Finally, in 1867, Alaska was sold to the Americans for a little more than \$7 million."

## ESKIMOS OBJECT TO MINING PERMITS

The New York Times

OTTAWA, April 10—Canadian Eskimos, angered over the granting of permits to prospect for uranium and other minerals in lands claimed by them, have demanded the resignation of the Minister of Indian Affairs, J. Judd Buchanan.

In a meeting with Prime Minister Pierre Elliott Trudeau and his cabinet on Feb. 27, Eskimo leaders laid formal claim to 250,000 square miles of land in northern Canada, and special rights over an additional 500,000 square miles of land and 800,000 square miles of water. They asked that the entire area, comprising more than a fifth of all Canada, be made a separate jurisdiction and eventually a new predominantly Eskimo province.

Prime Minister Trudeau said that the Government would consider the land claims "with a sense of urgency."

James Arvaluk, President of the Eskimo Brotherhood, now says that the friendly spirit of the meeting has been undercut by the granting, without prior consultation, of 68 new permits to search for uranium in an area claimed by the Eskimos.



**ICY SEAS** —The U.S. Revenue Marine's ship "Bear" is seen in icy seas during 1890 voyage taking reindeer. The photo, one of a number in the book "Arctic Passage," is from the University of Alaska Archives.

# Bering Sea past chronicled

**ARCTIC PASSAGE.** By William R. Hunt. Charles Scribner & Sons. 395 pages. \$12.95

Beginning with exploration and conquest, continuing through present day pacts and boundaries, and projecting into the future, "Arctic Passage" is an excellent chronicle of an often overlooked part of American history.

Written by University of Alaska history professor Dr. William R. Hunt, the book reads well and places historical events in a proper perspective.

Carefully documenting his facts, Hunt leads the reader through Alaska's history from the time of the earliest Russian explorers.

Hunt holds no favorites in his analysis of history around the Bering Sea, showing first the ruthless and inhumane treatment of Alaskan Natives — the Aleuts in particular — by the early Russians. (But he carefully notes that warfare was not an entirely new concept to the Natives).

Hunt later shows the shoddy treatment sailors aboard American whalers often received during the 1800's, and the eventual decline of whaling because of overharvesting and other factors.

Hunt notes also the farcical efforts in the Bering Sea during three major wars. Perhaps the most interesting is a campaign waged against American whalers by Capt.

James Waddell, backed by Confederate agent James D. Bullock, during the Civil War. Waddell's efforts, which resulted in the capture and destruction of many whalers months after the war had ended, were a major factor in the decline of whaling.

Hunt also details facts little known to most Americans, for example, the tenure of Wyatt Earp as a boxing promoter in Nome. Prior to his arrival there, Hunt recounts, Earp had played many roles, including horse thief, buffalo hunter, miner, peace officer and saloon operator.

"But in 1899, Earp added his talents to those of other Nome characters who were intrigued by boxing, and what a galaxy they represented," Hunt writes, "Besides (Tex) Rickard, who would later make the million-dollar gate commonplace, there were Jack "Doc" Kearnes, Tommy Burns, Wilson Mizner, and Mike Mahoney."

Hunt chronicles the famed gold rush to Alaska, which began in 1899, development of commerce, the fur seal trade and the international controversy it sparked, and much more.

The book ought to be required reading for any course in Alaskan history, but its readability makes it good reading for anyone interested in gaining a better understanding of Alaska and its past.

Daily News-Miner, Fairbanks

—Scott Anderson



## Capt. M. J. Brennan Dies; Helped Byrd Reach North Pole

Capt. Michael J. Brennan, who commanded the ship that participated in the successful North Pole expedition by Admiral Richard E. Byrd in 1926, died June 23 in Sailors Snug Harbor, Richmond Terrace, Staten Island. He was 87 years old.

Captain Brennan had spent most of his life at sea under sail and then steam after shipping out at the age of 15.

The Chantier, which Captain Brennan commanded on the polar trip, sailed from New York. The vessel carried the three-engine Fokker aircraft Josephine Ford to King's Bay, Spitzbergen. There the aircraft was lifted off the ship, and, with Floyd Bennett as pilot, it flew Admiral Byrd to the North Pole and back May 9, 1926.

They became the first men to fly over the Pole, followed two days later by the flight of Roald Amundsen and Umberto Nobile, in the semi-rigid aircraft Norge.

Captain Brennan participated in a ticker-tape parade up lower Broadway in honor of Admiral Byrd and his men.

A native of County Clare, Ireland, Captain Brennan came to the United States in 1910 and became a citizen. He switched from sail to steam in 1914, served in the United States Navy at sea during World War I and then returned to command merchant marine ships.

Captain Brennan, who is believed to have been one of the last of the Byrd expedition to survive, had lived at 580 84th Street in the Bay Ridge section of Brooklyn.

He is survived by his wife, Ann Wage and a brother. There will be a requiem mass at 9:30 A.M. tomorrow in St. Anselm's Church, Brooklyn. Burial will be in the United States National Cemetery, Pinelawn, L.I.

### Find in Siberia Reported

MOSCOW, Jan. 31 (Reuters) —Soviet geologists working in Siberia have found part of a woolly mammoth's hind leg that still had hair on it, the Tass news agency said.

The discovery was made at the world's northernmost camp site of Paleolithic man, dating back 8,000 years, on a tributary of the Indigirka River in the Yagut region.

The leg was among bone remnants of different animals, thought to be all that was left of a meat store made by early hunters.

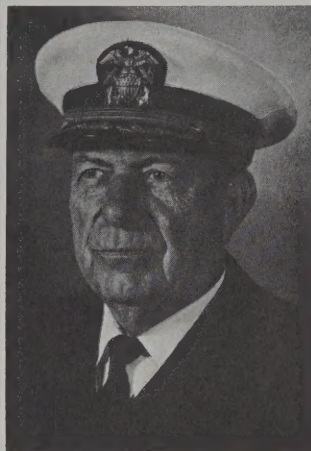
# Charles L. Kessler Dies; Traveled With Adm. Byrd

WASHINGTON, Jan. 5 —

Capt. Charles L. Kessler, a naval officer who accompanied Adm. Richard Byrd to the North and South Poles, and former director of the Virginia Selective Service, died of cancer Saturday at his home in Richmond. He was 72.

Capt. Kessler was born in Georgetown and attended public schools in Washington. He entered military service as a Marine in 1922; he served in the U.S. Navy 40 years. He had lived in Richmond since 1940.

In the late 1920s, Capt. Kessler traveled to the North Pole with Adm. Byrd, and went to the South Pole with the admiral in the 1930s. Thirty years later, he became a member of the Deep Freeze Expedition to Antarctica. He received a special congressional medal for his polar work.



CHARLES L. KESSLER

Kessler Peak, a mountain in the Queen Alexandra Range, was named after the captain in 1966.

In 1960, Capt. Kessler was appointed by President Eisenhower to head Virginia's Selective Service department. He retired in 1970.

Capt. Kessler was active in several clubs and organizations, including the Adventurers and Explorers clubs of New York, the Antarctic Society of Washington, the American Legion and its 40 and 8 Society, the Sons of Confederate Veterans, the Navy League, the Military Order of World Wars, the Reserve Officers Association of the U.S., and the Writers' Club of Virginia.

Following his retirement, Capt. Kessler became a lecturer and speaker.

His survivors include his wife, Juel; a daughter, Rita Barte, two grandchildren and two great-grandchildren, all of Richmond.

## RICHARD FLINT, 74, GEOLOGY PROFESSOR

Dr. Richard F. Flint, emeritus professor of geology at Yale and a leader in the application of the radiocarbon method to the dating of glacial periods, died June 5 at his home, 265 Bradley Street, New Haven, Conn. He was 74 years old.

Dr. Flint, who stepped down in 1970 as Henry Barnard Davis professor, remained active in the field and had just finished preparing a new edition with Brian Skinner of "Physical Geology," which first appeared in 1932.

He was chairman in 1939-45 of the compilation committee for the glacial map of North America for the National Research Council. He presided at the 1965 congress of the International Quaternary Association, dealing with pleistocene and recent geology.

Dr. Flint was born in Chicago. A Phi Beta Kappa graduate of the University of Chicago in 1922, he received his Ph.D. there in 1925 and joined the Yale faculty. He was chairman of the geology department from 1957 to 1964.

Surviving are his wife, the former Margaret Cecil Haggott; a daughter, Ann Ogilvy; three grandchildren and one great-grandchild.

## Beaufort Study Fails Objectives

INUVIK, N.W.T. (AP) — The acting director of the Canadian government's arctic biological station at Ste. Anne de Bellevue, Que., says the Beaufort Sea project, an environmental study jointly funded by the government and oil companies, has failed to achieve its objectives.

Dr. Ted Grainger and four other federal government biologists told the Berger Inquiry that offshore drilling in the Beaufort Sea, if allowed to proceed at this time, carries unknown risks to the ecology as current knowledge of even the basic biology of the area is extremely limited.

Dr. Grainger said the 18-month \$12-million project, completed at the end of 1975, "did not achieve its expectations in terms of range of coverage either in space or in time."

The arctic petroleum operation association contributed one-third of the project cost.

"No part of the actual Beaufort Sea project open-water study, and this applies to the work undertaken in 1974 and

1975, was carried out under favorable circumstances," he told the commission headed by Justice Thomas Berger of the Supreme Court of British Columbia.

"The ship-supported surveys of the two summers failed so badly to achieve the schedules planned for them... a number of rather elementary questions concerning base-line features of this ecosystem therefore remain unanswered. Such gaps show the report to be even more of a preliminary one than it was hoped it would be when the plan was conceived."

Dr. Grainger was not alone in criticizing the project. Said Dr. Jonathan Percy, a biologist at the station:

"In view of the great complexity of potential interactions between oil and animal communities, it would be manifestly impossible in a study of limited duration such as the Beaufort Sea project to explore more than a few of the myriad aspects of the problem."





CRREL (Cold Regions Research and Engineering Laboratory), Hanover, NH, scientists, engineers and specialists team their talents in an interdisciplinary approach to the planning and conduct of over-all Army research, development, test and evaluation programs focused on problems of military operations ... "applicable to ... those geographic areas of the world where cold presents a severe problem at least one year in 10..."

Typical areas of concern include road and airfield pavement structures, foundations, building structures and utilities systems.

**CRREL feature article begins on page 16.**

